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# Using Column Lysimetry to Evaluate Acid Precipitation Effects

Alfred Ray Harris and Douglas M. Stone

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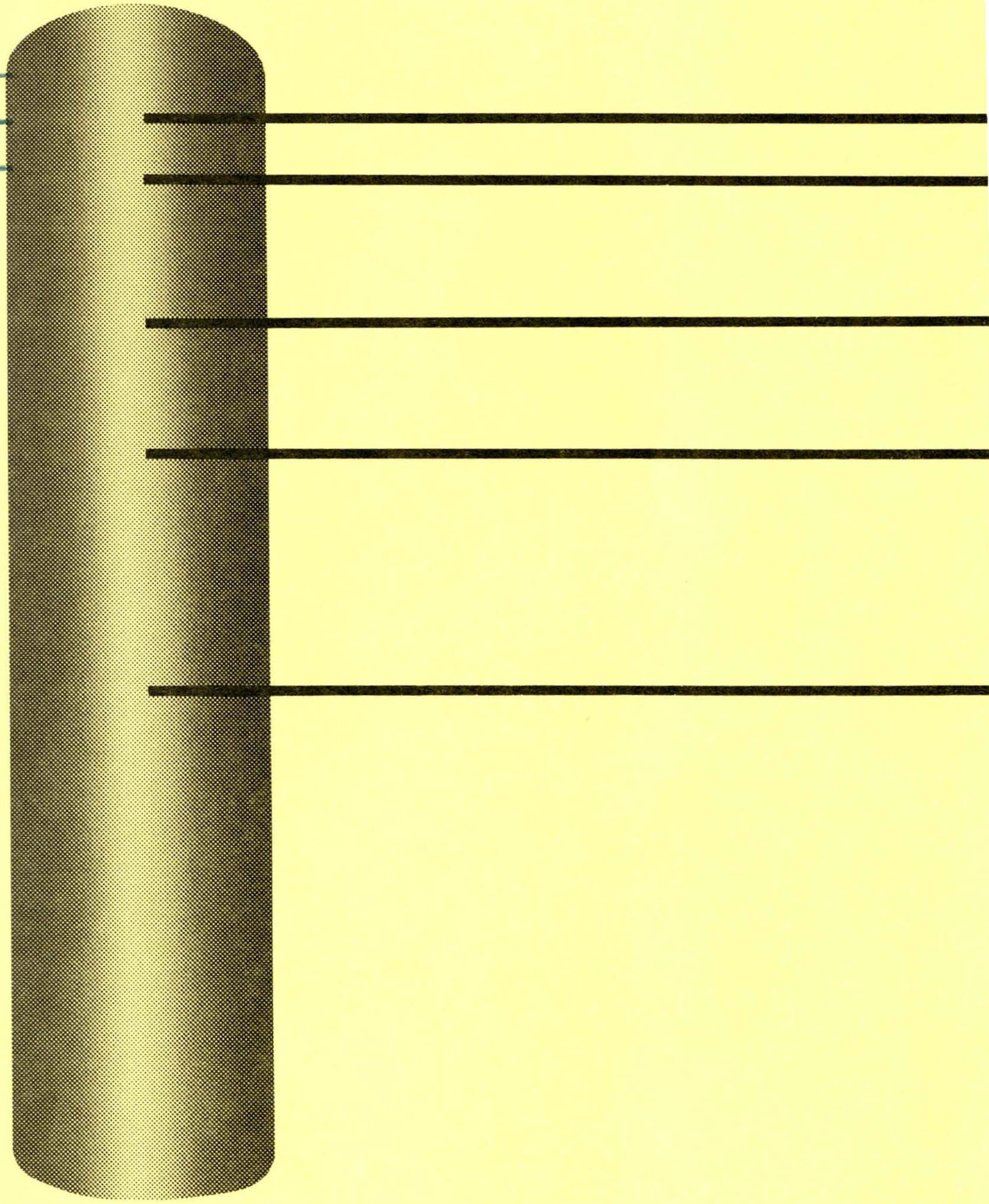

## CONTENTS

Page

SITE CHARACTERISTICS ..... 1
  Study Area ..... 1
  Vegetation ..... 3
  Soils ..... 3
LYSIMETER METHODOLOGY ..... 4
  Soil Columns ..... 4
  Instrumentation ..... 4
  Sample Collection Building ..... 5
  Pretreatment and Analyses ..... 6
EXPERIMENTAL APPROACH ..... 6
  Experimental Design ..... 6
  Treatments ..... 6
RESULTS AND DISCUSSION ..... 6
SUMMARY ..... 7
ACKNOWLEDGMENTS ..... 7
LITERATURE CITED ..... 8
TABLES ..... 9
APPENDIX1-5 ..... 14

**North Central Forest Experiment Station**
**Forest Service—U.S. Department of Agriculture**
**1992 Folwell Avenue**
**St. Paul, Minnesota 55108**
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**1990**

# USING COLUMN LYSIMETRY TO EVALUATE ACID PRECIPITATION EFFECTS

## Alfred Ray Harris and Douglas M. Stone

Acidification of forest soils by precipitation and internally generated acids can accelerate leaching of basic cations (Ca, Mg, K, and Na), resulting in reduced soil fertility. Soil acidification also may result in increased concentrations of aluminum in the soil solution; when this solution moves to open waters, it can have deleterious effects on aquatic ecosystems.

Lakes and streams may be acidified by direct precipitation and from water channeled through surrounding soils. Also, it is hypothesized that water in soils with low base saturation and high anion input can produce highly acidic percolate after prolonged soil contact and subsequent degassing in surface waters.

Theories advanced by Reuss (1983), Reuss and Johnson (1985), and Seip and Rustad (1984) suggest that water in soils with less than 15 percent base saturation is susceptible to pH depression of up to 0.4 units, which is sufficient to cause negative alkalinity in the solution. High concentrations of mobile anions (notably $SO_4$) are responsible for the negative alkalinity, and these solutions upon $CO_2$ degassing in surface waters can retain acidities of pH 5.0 or less.

The impact of acid precipitation on nutrient depletion, solubilization of toxic elements, acidification of open waters due to anion loading of the soil, and transport of unbuffered acid precipitation through watersheds is not well known. This research was designed to determine whether these soil processes are important to the acidification of lakes located in the nutrient-deficient, sandy outwash plains of the Superior Uplands.

The specific objective of the study was to determine the sensitivity of soils with low base-saturation to increased anion loadings and the susceptibility of these soil solutions to pH depression and negative alkalinities. A secondary objective was to determine whether reduced sulfate deposition will reverse the acidification processes and return soil water alkalinities from negative to positive.

This paper describes the experimental design and approach used to solve problems encountered with soil column collection, instrumentation, materials and methods, and maintenance of natural soil temperatures. Some preliminary results are presented. Also, basic data on the soil and vegetation of the sampled sites are included to form a database for use by forest soil scientists and land managers.

### SITE CHARACTERISTICS

#### Study Area

The Superior Uplands physiographic province includes large areas of forest land in the upper Great Lakes region. The province is covered to varying depths by glacial deposits that determine the topography, drainage patterns, and soil parent materials (Fenneman 1938). The region includes extensive areas of outwash plains where numerous lakes occupy basins formed by the burial and subsequent melting of ice blocks. Many of these lakes are sensitive to acidic deposition (Nichols and McRoberts 1986). Nine sites representative of large areas of infertile, sandy soils with base saturations in a range of 1 to 40 percent were sampled (fig. 1). Average annual precipitation ranges from 600 to 850 mm and pH ranges from 5.0 to 4.7 across the region.

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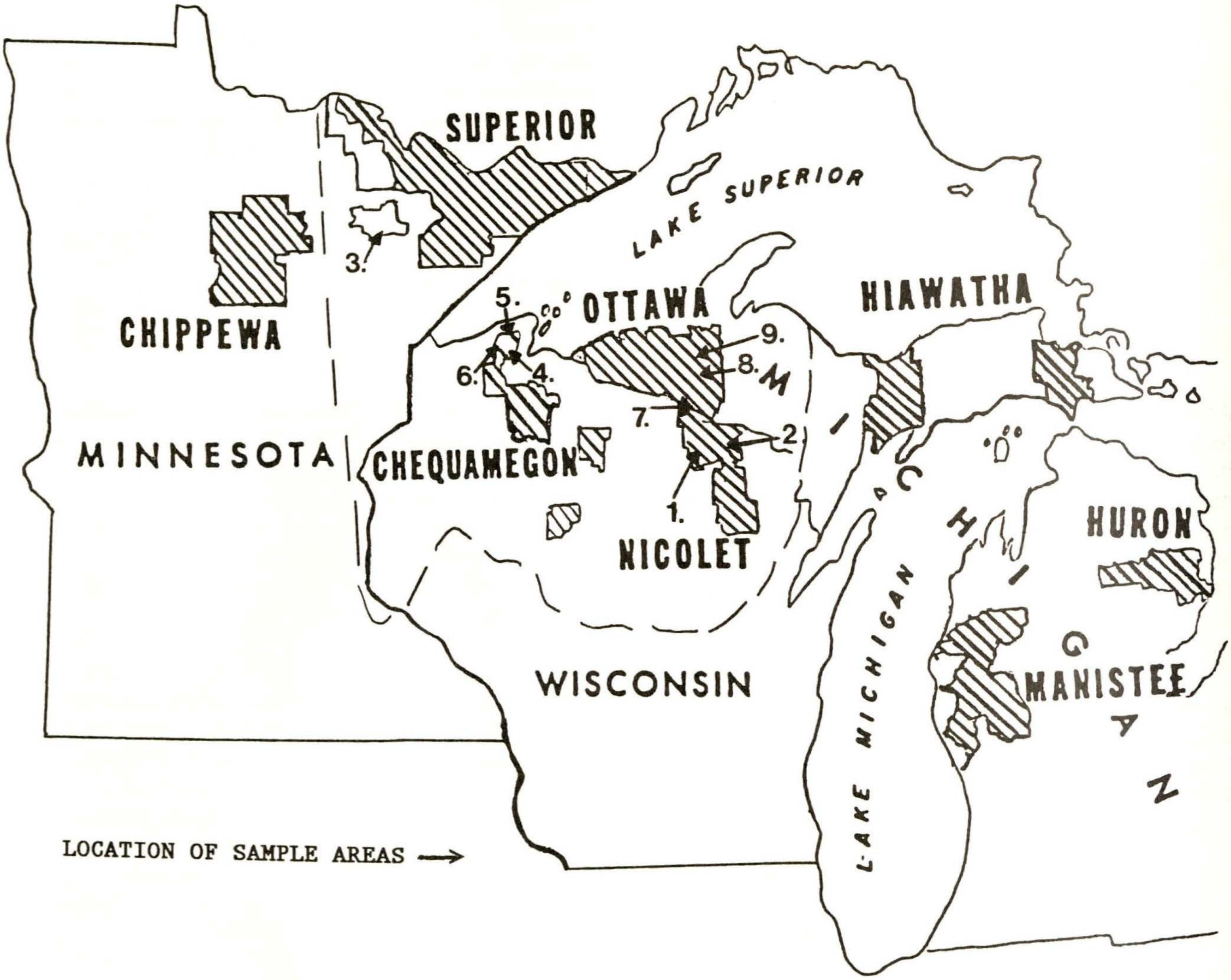
SUPERIOR
LAKE SUPERIOR
CHIPPEWA
3.
5.
OTTAWA
HIAWATHA
9.
8.
6.
4.
7.
2
MINNESOTA
CHEQUAMEGON
1.
NICOLET
HURON
WISCONSIN
MANISTEE
MICHIGAN
LAKE MICHIGAN
LOCATION OF SAMPLE AREAS →

| SITE NO. | LOCAL NAME | NATIONAL FOREST | RANGER DISTRICT | STATE | COUNTY | -- LEGAL | DESCRIPTION | -- |
|---|---|---|---|---|---|---|---|---|
| | | | | | | TOWN | RANGE | SECTION |
| 1 | Sevenmile Lake | Nicolet | Eagle River | WI | Forest | 39 N | 12 E | 7 |
| 2 | Brule Creek | Nicolet | Eagle River | WI | Forest | 40 N | 13 E | 4 |
| 3 | Dark Lake | Superior | Virginia | MN | St. Louis | 60 N | 19 W | 29 |
| 4 | Long Lake | Chequamegon | Washburn | WI | Bayfield | 48 N | 6 W | 1 |
| 5 | Horshoe Lake | Chequamegon | Washburn | WI | Bayfield | 48 N | 6 W | 18 |
| 6 | Sawdust Lake | Chequamegon | Washburn | WI | Bayfield | 48 N | 7 W | 32 |
| 7 | Lac Vieux Desert | Nicolet | Eagle River | WI | Vilas | 42 N | 11 E | 7 |
| 8 | Trout Creek | Ottawa | Kenton | MI | Ontonagon | 47 N | 38 W | 27 |
| 9 | Baraga Plains | Ottawa | Kenton | MI | Baraga | 49 N | 35 W | 36 |

Figure 1.—*Location of sample sites in the Superior, Chequamegon, Nicolet, and Ottawa National Forests. Heavy dashed line indicates approximate boundary of the Superior Uplands.*

## Vegetation

The predominant species in the overstory, shrub layer, and ground flora of each site are listed in descending order of abundance (table 1). The vegetation on sites 1, 2, and 4 to 7 were classified as Acer-Quercus-Vaccinium using the system of Kotar *et al.* (1988); site 8 was Tsuga-Maianthemum, and site 9 was Pinus-Vaccinium-Deschampsia (Coffman *et al.* 1984). Site 3 on the Superior National Forest was classified using different nomenclature (table 1).

Soils with the lowest base saturation (0 to 10 percent) supported stands with a sparse overstory of jack pine and/or oak. Red maple, paper birch, quaking aspen, and red pine were the most common associated species. A shrub layer frequently was absent on these sites or consisted only of widely scattered pin cherry, juneberry, or oak. The ground flora generally consisted of a sparse cover of reindeer moss, sweet-fern, blueberry, and occasionally bracken fern and mixed grasses.

Relatively open stands of red pine, jack pine, and oak occupied the medium-base (10 to 20 percent) sites, with white pine, paper birch, and aspen as common associates. When present, the shrub layer consisted of scattered pin cherry, oak, and juneberry. Ground flora included sweet-fern, blueberry, bracken fern, raspberry, and woodland strawberry, with reindeer moss and mixed grasses on some sites.

Soils with the highest base saturation (20 to 40 percent) supported stands with closed canopies of white pine, red pine, white spruce, birch, and aspen. These sites generally had a well-developed shrub layer consisting of white pine, red pine, balsam fir, aspen, birch, hazel, and red maple. The ground flora was more abundant and included bracken fern, blueberry, wintergreen, club-mosses, wild strawberry, ground-pine, and seedlings of the overstory species.

## Soils

The sites selected for sampling had rapidly permeable sand soils of moderately weathered glacial outwash; these soils ranged in drainage capacity from somewhat excessively to somewhat poorly drained. Sample columns were collected using schedule 35 polyvinyl chloride (PVC) plastic pipe to contain the soil. A column from the center of each site was used for identifying the classification of the soil profile and for characterizing the physical and chemical properties. The litter-humus layer was removed from each column and weights and chemical characteristics were determined on a composite sample from each site (table 2 and Appendix 1).

The ecological land forms for each site are listed as follows:

Site 1 - Hummocky kame-kettle complex. Slopes are complex and range to 50 percent. Local relief is to 100 feet. Glacial materials are sandy outwash sediments.

Site 2 - Nearly level, outwash plain. Slopes are simple and less than 6 percent. Local relief is less than 200 feet. Glacial materials are sandy.

Site 3 - Undulating outwash plain. Local relief is less than 10 feet. Glacial materials consist of outwash sands over grey clay or grey till.

Sites 4,5,6 - Pitted outwash plain. Glacial materials consist of sands and gravel.

Site 7 - Nearly level outwash plain. Slopes are less than 6 percent. Local relief is 20 feet.

Site 8 - Hilly, recessional moraine. Slopes are complex and range from 10 to 25 percent. Local relief is up to 100 feet. Glacial materials are sandy till.

Site 9 - Nearly level, stabilized dune features on lake plain. Slopes are complex and up to 8 percent. Maximum local relief is 20 feet.

The mineral soil from each site was identified as either Haplorthod or Udipsamment. Complete soil profile descriptions are given, in Appendix 2. A soil column from each site was divided into 5-cm depth increments, and standard physical and chemical properties were determined. Table 3 shows mean texture, pH, cation exchange capacity (CEC), and base saturation values. The soils were predominantly sands, grading to almost pure sands at the

150-cm depth. Mean pH measured in water ranged from 3.9 to 5.7 and in 0.02 M $CaCl_2$ from 3.7 to 5.1. In general, pH increased with depth. Cation exchange capacity decreased with depth and with increasing percentage of sand, varying from 23.3 to less than 1 cmole/kg. Base saturation varied with depth, making it impossible to classify an individual soil column in a given base saturation range. However, because leachate was extracted at several depths, the effect of base saturation levels could be tested. Base saturation ranged from 3 to 36 percent. Detailed physical and chemical soil characteristics for each site are listed in Appendix 2-4.

## LYSIMETER METHODOLOGY

### Soil Column

Intact soil columns were collected in fall of 1984. Schedule 35 PVC collection pipes were cut in 150-cm (60-in.) lengths and beveled on one end with a router (fig. 2). Most of the columns were collected using bevel type A. All four types of bevels were tried to determine which would best penetrate sandy or fine gravelly soils with minimum disturbance.

The columns were collected by setting the pipes upright and pressing them into the soil with a backhoe. At most of the sites, the pipes could only be pressed into the soil about 120 to 140 cm without distorting the penetrating end of the pipe. A trench was dug beside the pipes to the depth of penetration, a plastic Caplug was taped tightly to the top of each, and the pipe was inverted. If the columns had not penetrated to 150 cm, they were backfilled with soil from the appropriate depth. The bottoms of the pipes were then capped and taped, and the columns were transported to the USDA Forest Service's Forestry Sciences Laboratory at Grand Rapids, MN.

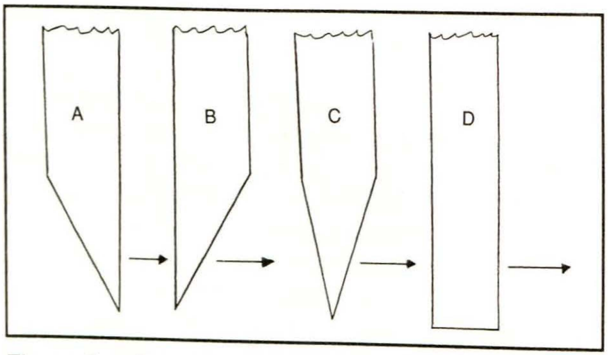

Figure 2.—*Four bevel types of penetrating ends of PVC pipe used to collect soil columns: (A) outside, (B) inside, (C) pointed, and (D) blunt. Arrow points to inside of pipe.*

### Instrumentation

Each pipe was drilled at prescribed depths, and soil was extracted from the edge to the center of the column with a cork borer (fig. 3). Porous polyethylene filter candles (70-micron pore size) with polyethylene drainage tubes were inserted into the holes. Both the candle and the drainage tube were sealed to the edge of the pipes with thermal glue. The filter candles were used to collect both gas and water samples. A 0.635-cm-thick, 70-micron porous polyethylene sheet was placed on the bottom of the column above a corrugated plastic mat to facilitate drainage. A support collar and polyethylene plate were then sealed over the end with thermal glue. A collar was glued to the top of each tube, and an extension sealed by a gasket and caulking was placed in the collar. This extension holds the litter-humus layer and treatment precipitation. The columns were reburied to simulate normal soil temperatures.

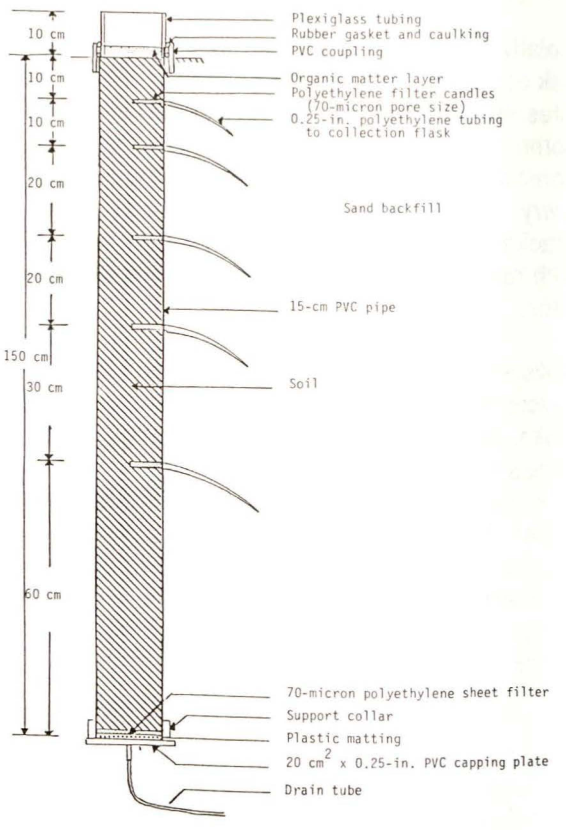
10 cm
10 cm
10 cm
20 cm
20 cm
150 cm
30 cm
60 cm
Plexiglass tubing
Rubber gasket and caulking
PVC coupling
Organic matter layer
Polyethylene filter candles (70-micron pore size)
0.25-in. polyethylene tubing to collection flask
Sand backfill
15-cm PVC pipe
Soil
70-micron polyethylene sheet filter
Support collar
Plastic matting
20 cm$^2$ x 0.25-in. PVC capping plate
Drain tube

Figure 3.—*Lysimeter with leachate collection system and extension to hold the litter-humus cap and treatment precipitation.*

Caps of the same diameter as the columns were made from ground litter-humus of jack pine, mixed hardwoods, or quartz sand and placed on the columns to provide three surface treatments. Grass was grown in the caps to stabilize the cover and to provide an active root system as a source of $CO_2$ in the soil columns.

### Sample Collection Building

A subterranean building was constructed to collect water and gas samples from the lysimeters (fig. 4). Building construction was similar to wood basement construction in the area. The top and sides of the building were insulated with 5-cm (2-in.) Thermax[1] (R 15) so the inside temperature would not influence the surrounding lysimeters. The roof was 15 cm (6 in.) below the soil surface and covered with sod to maintain a natural surface environment. The soil around the building was excavated, the columns were placed next to the building, the collection tubes were inserted through predrilled holes in the walls, and the holes were caulked to prevent water seepage into the building. Sand was used to backfill around the columns. A sump pump was installed to remove water collecting under the floor. A vacuum system was installed so leachate could be collected using small negative pressures on the sampling ports.

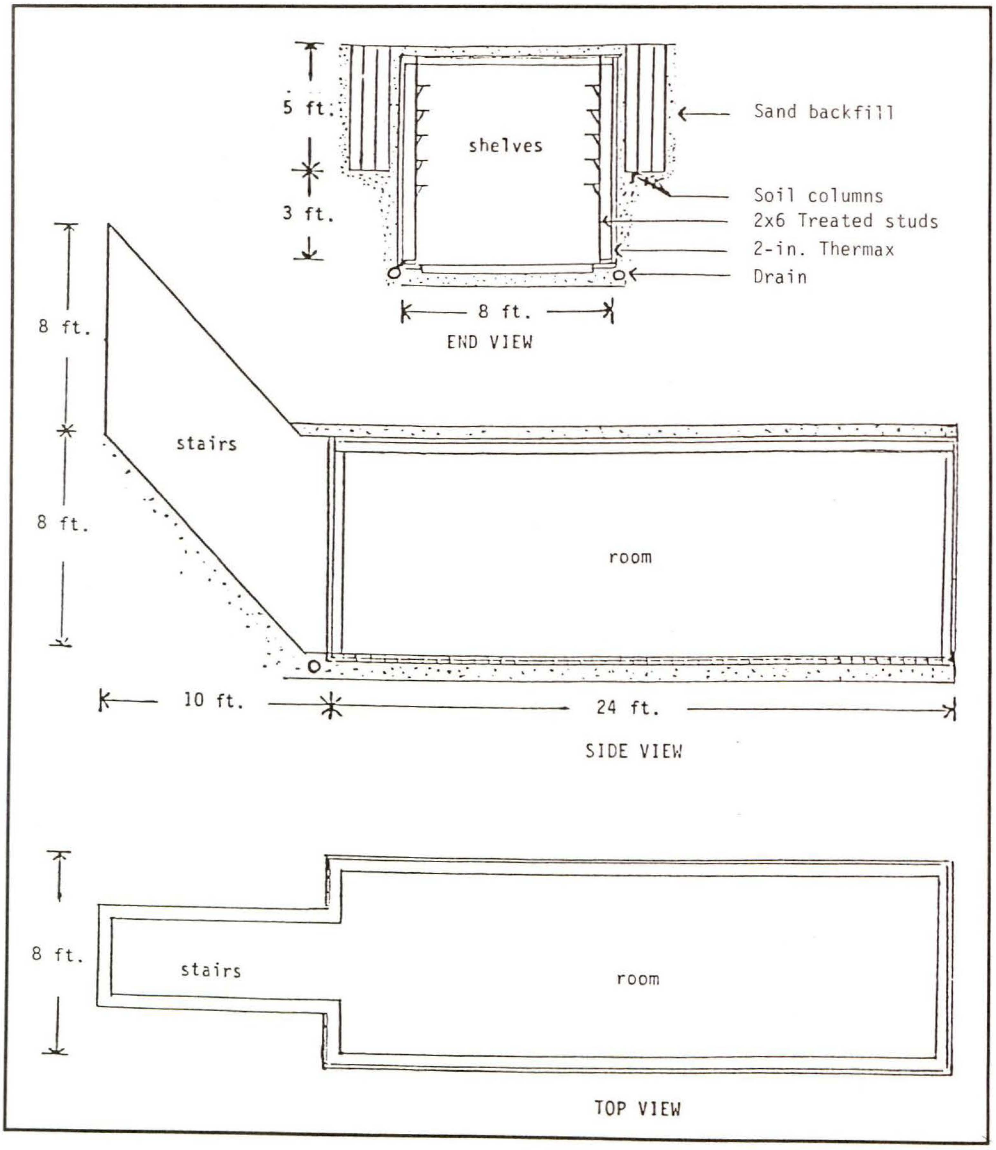
5 ft.
3 ft.
shelves
Sand backfill
Soil columns
2x6 Treated studs
2-in. Thermax
Drain
8 ft.
END VIEW
8 ft.
8 ft.
stairs
room
10 ft.
24 ft.
SIDE VIEW
8 ft.
stairs
room
TOP VIEW

Figure 4.—*Subterranean leachate collection building.*

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[1] *Mention of trade names does not constitute endorsement by the USDA Forest Service.*

### Pretreatment and Analyses

Before the 1985 treatment season began, the columns were leached with 300 mm of deionized water to stabilize them from disturbance and to equilibrate the initial water content. Plexiglass covers were placed over the columns to exclude ambient precipitation. Covers were opened during nonprecipitation periods during daylight hours over the treatment season.

Alkalinity, pH, Ca, Mg, K, Na, Al, Fe, Mn, Zn, Cd, Pb, Cu, Cr, Ni, B, P, $NO_3$, $SO_4$, Cl, and $PO_4$ in leachate samples were measured. Elemental concentrations were determined on a DC plasma emission spectrometer; total Kjeldahl nitrogen (TKN), total P, and $NH_4$ by AutoAnalyzer; $NO_3$, $SO_4$, Cl, and $PO_4$ by Ion Chromatography; total alkalinity by Gran plot; and pH by glass electrode.

## EXPERIMENTAL APPROACH

### Experimental Design

A split plot completely randomized design was used for the study. Three levels of base saturation formed the major plots; for each base saturation level, two precipitation pH levels (4.2 and 5.4) formed the subplots and three surface treatments (quartz sand, hardwood, and jack pine) formed the sub-subplots. Each treatment combination had four replications, for an overall total of 216 columns.

### Treatments

Two pH levels were used to investigate effects of acid precipitation on the soil samples: pH 5.4, the level in normal rainfall; and pH 4.2, the level present in high acid rain areas of the United States. Precipitation was collected from a glass greenhouse surface, stored in plastic containers, and adjusted to pH 4.2 or 5.4 with $H_2SO_4$+$HNO_3$(1:1 ratio) or NaOH. The adjusted precipitation was applied weekly during the frost-free season in 25- to 50-mm amounts. Approximately 1,500 mm, an amount similar to that falling in high acid rain areas of the eastern United States, were applied each year. Table 4 shows the mean seasonal pH, alkalinity, $NO_3$, and $SO_4$ values for rain collected in 1986 before and after adjusting to treatment levels. Two litter-humus types were tested to determine their acidifying or buffering effects on the soil columns. Surface litter-humus samples from jack pine and mixed hardwood sites were collected, air-dried, and coarsely ground. After mixing, 144-gm quantities of each litter-humus type were placed into 15-cm-diameter PVC rings and planted with bluegrass. Also, 300-gm quantities of quartz sand were put into rings and planted with grass. The sand treatment was for purposes of comparison and to simulate sites with little or no organic matter. The litter-humus or sand caps were placed on the soil columns before precipitation treatments began.

## RESULTS AND DISCUSSION

This experiment has been in progress for 4 years. Leachate samples have been collected regularly and complete chemical analyses are continuing. Gas samples are now being collected and analyzed. Although collecting, transporting, instrumenting, and maintaining the soil lysimeters worked as outlined, some changes would improve similar experiments in the future. For example, most of the soil columns were collected using an outside bevel on the pipes (fig. 2). We found that bevel types C and D usually did not cause the pipe to collapse while penetrating the soil. Type A tended to collapse inward and type B tended to split outward at greater depths. Schedule 40 pipe would decrease collapse and splitting. Types A and D do not compact the soil columns as the pipe penetrates. Some edge compaction may result with types B and C, but this may be advantageous because the soil must seal against the inner wall of the pipe to prevent water channeling. The blunt end (type D) requires more penetration force, and roots are torn and dragged along the wall of the pipe and not cut as with the beveled types. If this procedure were to be repeated, schedule 40 PVC pipe with bevel C would probably be used.

The 70-micron porous polyethylene candles used to collect soil-water samples worked well where a saturated wetting front was present and a slight negative pressure was used on the collection tubes. However, we generally could not collect water below 40 cm except at the bottom drain. Candles with a smaller pore size probably would be more effective in collecting tension water.

With freezing and thawing, the glued joints on some of the bottom cover plates cracked, allowing soil water to escape the column or percolating soil water to enter. This did not affect sample collection, but we could not determine the water budget for those columns and some samples were contaminated. PVC caps are now available that fit over the end of the pipe, eliminating the problem of joint failure.

Because of the many analyses required and the large number of samples, only acidification results have been completed and analyzed. Soil-water acidity changed significantly between the first- and second-year fall measurements (table 5). This occurred at the 10-, 20-, and 150-cm depths but could not be confirmed for the 40-cm depth due to insufficient data. In 1988, soil-water alkalinity was negative at the 10-, 20-, and 40-cm depths for both pH treatments; the pH 4.2 treatment had the lowest alkalinities. After the first year, pH and alkalinity were not different at the 10-, 20-, and 40-cm depths, but remained different at the 150-cm depth. A new equilibrium was evidently reached in the system because pH and alkalinity values changed little after the first year.

Soil-water pH and alkalinity at 150 cm were much lower after the first year of treatment. Alkalinity in the leachate increased at the 150-cm depth, probably due to accelerated removal of exchangeable cations from upper horizons or adsorption of $SO_4$ at the lower depths. Alkalinities and pH at the 10-, 20-, and 40-cm depths were significantly lower than those at the 150-cm depth.

Although the soil water became more acidified with both pH treatments, pH and alkalinity were lower under the pH 4.2 treatment. Type of litter-humus also affected acidification; hardwood and to a lesser extent jack pine litter-humus had a buffering effect (table 6). Leachate from soil columns without surface litter-humus was more acid in the upper levels for both pH treatments. Litter-humus treatment effects on pH disappeared with depth.

Leachate alkalinity was also lowest in columns without a litter-humus surface (table 7). Alkalinity and pH were significantly higher at the 150-cm depth than at the lower depths for all treatments. Alkalinity and pH did not differ significantly at the 10-, 20-, and 40-cm depths under the hardwood litter-humus caps for either pH treatment, probably due to acid neutralization by the hardwood humus layer. Jack pine litter-humus did not buffer the soil water as effectively as hardwood litter-humus. There did not appear to be any real seasonal differences for either soil-water pH or alkalinity for any of the treatments.

## SUMMARY

Intact soil columns were collected, transported to a central lab, and instrumented as soil water lysimeters. The lysimeters were reburied around an underground collection structure to maintain normal soil temperatures. Hardwood or jack pine litter-humus caps or quartz sand were applied to the columns to test the buffering effect of the organic surface layer. Two pH treaments were applied to the lysimeters: pH 5.4 to represent normal rainfall, and pH 4.2 to represent acid rainfall.

Acidification of the soil water was significant in the first year under both pH treatments. Acidity did not change significantly with three additional years of treatment. The hardwood organic layer had the greatest buffering effect. Treatment effects on pH and alkalinity were greatest near the surface and decreased with depth.

The experimental system succeeded in treating the soils and measuring the desired parameters to determine acidification of soil water under acid precipitation, but some improvements in lysimeter construction and instrumentation are recommended. The lysimeters and treatments were designed to simulate natural conditions so that results would be applicable to field conditions. Basic data have been gathered on the soils sampled to form a database for soil scientists, soil classifiers, and land managers in the Lake States region.

## ACKNOWLEDGMENTS

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Table 1. Classification and predominant vegetation on the sample sites in order of decreasing abundance. (Coffman *et al*. 1984; Kotar *et al*. 1988; USDA Forest Service Handbook, 1975 and 1979)

| Site | Classification | Overstory | Understory | Ground Flora |
|---|---|---|---|---|
| 1 | Acer-Quercus-Vaccinium | Red Pine (*Pinus resinosa*)<br>Jack Pine (*Pinus banksiana*)<br>White Pine (*Pinus strobus*)<br>White Birch (*Betula papyrifera*)<br>Quaking Aspen (*Populus tremuloides*) | Pin Cherry (*Prunus pensylvanica*)<br>Red Oak (*Quercus rubra*)<br>Juneberry (*Amelanchier* spp.) | Bracken Fern (*Pteridium aquilinum*)<br>Sweet-fern (*Comptonia peregrina*)<br>Blueberry (*Vaccinium* spp.)<br>Reindeer Moss (*Cladonia* spp.)<br>Grasses<br>Woodland Strawberry (*Fragaria vesca*) |
| 2 | Acer-Quercus-Vaccinium | White Pine<br>Aspen<br>Red Pine<br>White Birch | White Pine<br>Aspen<br>Red Pine<br>White Birch | Bracken Fern<br>Big Leaf Aster (*Aster macrophyllus*)<br>Wintergreen (*Gaultheria* spp.)<br>Blueberry |
| 3 | Os-3,*<br>Sh-1,<br>Fo-2 | Scattered Residual Red Pine<br>Scattered Jack Pine<br>Underplanted Pole-sized Red Pine | Balsam Fir (*Abies balsamea*)<br>Red Pine<br>White Pine<br>Willow (*Salix* spp.)<br>White Birch<br>Aspen<br>Hazel (*Corylus cornuta*)<br>Alder (*Alnus* spp.) | Blueberry<br>Bracken Fern<br>Club-moss (*Lycopodium* spp.)<br>Reindeer Moss<br>Grasses<br>Sweet-fern<br>Strawberry |
| 4 | Acer-Quercus-Vaccinium | Red Oak<br>Jack Pine<br>Scattered White Birch<br>Scattered Red Maple (*Acer rubrum*) | | Sweet-fern<br>Bracken Fern<br>Grasses |
| 5 | Acer-Quercus-Vaccinium | Scattered Jack Pine<br>Aspen<br>Scrub Oak (*Q. ilicifolia*) | | Sweet-fern<br>Mixed Grasses<br>Raspberry (*Rubus* spp.) |
| 6 | Acer-Quercus-Vaccinium | Jack Pine<br>Scrub Oak | | Sweet-fern<br>Mixed Grasses<br>Reindeer Moss |
| 7 | Acer-Quercus-Vaccinium | Red Pine<br>White Pine<br>White Spruce (*Picea glauca*) | Red Maple<br>Sugar Maple (*A. saccharum*)<br>White Birch<br>Hazel<br>Aspen<br>Balsam Fir | Bracken Fern<br>Birch Seedlings<br>Ground-pine (*Lycopodium obscurum*)<br>Club-moss<br>Blueberry<br>Wintergreen |
| 8 | Tsuga-Maianthemum | Red Maple<br>Aspen<br>Jack Pine<br>White Birch | | Reindeer Moss<br>True Moss<br>Wintergreen<br>Mixed Grasses<br>Raspberry |
| 9 | Pinus-Vaccinium-Deschampsia | Mixed Natural Jack Pine<br>Planted Jack Pine | | Reindeer Moss<br>Grasses<br>Sweet-fern<br>Blueberry<br>Willow |

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[*] Used exclusively by the Superior National Forest and referenced in USDA Forest Service Handbook (1975, 1979).

Table 2. Litter-humus values for Kjeldahl N, total P, total S, exchangeable cations cation exchange capacity, base saturation, pH, and weight for each site and surface treatment

| Site-trt. | TKN | Total P | Total S | Exchangeable cations Ca | Mg | K | Na | H | CEC | Base sat. | pH | Weight |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | - - - - | - - - | - - - | -(mg/kg)- | - - - | - - - | - - - | - | (cmole/kg) | (%) | | (t/ha) |
| 1 | 14150 | 750 | 2260 | 2780 | 520 | 550 | 180 | 41 | 60.8 | 32 | 4.5 | 24 |
| 2 | 5350 | 655 | 990 | 4400 | 670 | 900 | 190 | 22 | 52.3 | 58 | 5.2 | 15 |
| 3 | 7250 | 710 | 1260 | 2740 | 510 | 700 | 190 | 38 | 58.1 | 35 | 4.6 | 23 |
| 4 | 10000 | 730 | 1850 | 2120 | 280 | 430 | 180 | 40 | 54.4 | 27 | 4.4 | 15 |
| 5 | 11100 | 715 | 1800 | 2000 | 320 | 910 | 200 | 32 | 48.2 | 33 | 4.5 | 14 |
| 6 | 10100 | 755 | 1760 | 1680 | 220 | 650 | 190 | 31 | 44.1 | 29 | 4.4 | 16 |
| 7 | 10050 | 855 | 1180 | 4630 | 620 | 810 | 180 | 34 | 64.9 | 48 | 5.0 | 28 |
| 8 | 9350 | 780 | 1650 | 3330 | 440 | 370 | 180 | 38 | 59.8 | 37 | 4.5 | 21 |
| 9 | 8200 | 630 | 1360 | 860 | 80 | 320 | 180 | 48 | 55.0 | 12 | 3.8 | 13 |
| MH * | 11200 | 1350 | 1660 | 9630 | 1090 | 850 | 260 | 20 | 80.1 | 75 | 5.6 | 79 |
| JP * | 9600 | 1060 | 1710 | 4580 | 810 | 700 | 240 | 38 | 70.4 | 46 | 4.7 | 79 |
| QS * | 1900 | 605 | 200 | 370 | 130 | 200 | 50 | 2 | 5.7 | 64 | 6.1 | -- |

* Mixed hardwood (MH), jack pine (JP), and quartz sand (QS) treatment caps with an established grass cover.

Table 3. Soil classification and physical and chemical properties averaged over selected depths

| Site | Soil classification | Depth | Texture | | | pH | | CEC | Base sat. |
|---|---|---|---|---|---|---|---|---|---|
| | | | Clay | Silt | Sand | $H_2O$ | $CaCl_2$ | | |
| | | (cm) | - - - - | -(%)- | - - - - | | | (cmole/kg) | (%) |
| 1 | Sandy, mixed, frigid Entic Haplorthod | 0-10 | 4 | 11 | 85 | 3.9 | 3.7 | 10.1 | 9 |
| | | 10-20 | 3 | 9 | 88 | 4.6 | 4.4 | 7.4 | 3 |
| | | 20-40 | 2 | 8 | 90 | 4.8 | 4.6 | 4.0 | 5 |
| | | 40-150 | 1 | 1 | 99 | 5.2 | 4.8 | 1.0 | 23 |
| 2 | Mixed, frigid, Aquic Udipsamment | 0-10 | 3 | 8 | 89 | 5.0 | 4.5 | 7.2 | 25 |
| | | 10-20 | 4 | 7 | 89 | 5.4 | 4.6 | 4.1 | 32 |
| | | 20-40 | 4 | 5 | 91 | 5.7 | 5.0 | 4.8 | 21 |
| | | 40-150 | 3 | 7 | 89 | 5.4 | 4.6 | 2.4 | 20 |
| 3 | Mixed, frigid Aquic Udipsamment | 0-10 | 4 | 9 | 87 | 4.7 | 4.3 | 16.1 | 25 |
| | | 10-20 | 5 | 6 | 89 | 4.9 | 4.4 | 10.4 | 13 |
| | | 20-40 | 3 | 4 | 93 | 5.6 | 5.0 | 5.6 | 20 |
| | | 40-150 | 1 | 1 | 98 | 5.5 | 4.9 | 1.3 | 36 |
| 4 | Sandy, mixed, frigid Entic Haplorthod | 0-10 | 4 | 9 | 88 | 4.0 | 3.7 | 9.9 | 5 |
| | | 10-20 | 4 | 9 | 87 | 4.4 | 4.1 | 6.3 | 5 |
| | | 20-40 | 2 | 7 | 91 | 4.9 | 4.6 | 4.7 | 4 |
| | | 40-150 | 2 | 4 | 94 | 5.4 | 5.1 | 0.8 | 15 |
| 5 | Mixed, frigid Typic Udipsamment | 0-10 | 4 | 3 | 93 | 4.3 | 3.9 | 6.2 | 10 |
| | | 10-20 | 5 | 3 | 93 | 4.4 | 3.9 | 5.7 | 8 |
| | | 20-40 | 4 | 1 | 96 | 4.9 | 4.7 | 3.6 | 5 |
| | | 40-150 | 2 | 2 | 96 | 5.3 | 4.8 | 0.6 | 21 |
| 6 | Mixed, frigid Typic Udipsamment | 0-10 | 5 | 5 | 91 | 4.7 | 4.2 | 7.6 | 12 |
| | | 10-20 | 5 | 4 | 92 | 4.9 | 4.4 | 6.3 | 9 |
| | | 20-40 | 4 | 4 | 92 | 5.0 | 4.5 | 4.3 | 6 |
| | | 40-150 | 2 | 2 | 97 | 5.2 | 4.8 | 0.9 | 15 |
| 7 | Sandy, mixed, frigid Entic Haplorthod | 0-10 | 6 | 19 | 75 | 4.4 | 4.1 | 23.3 | 29 |
| | | 10-20 | 6 | 14 | 80 | 4.5 | 4.2 | 16.9 | 9 |
| | | 20-40 | 4 | 12 | 84 | 5.1 | 4.6 | 8.7 | 9 |
| | | 40-150 | 1 | 10 | 88 | 5.2 | 4.6 | 2.8 | 10 |
| 8 | Mixed, frigid Spodic Udipsamment | 0-10 | 4 | 5 | 91 | 4.3 | 3.9 | 8.7 | 11 |
| | | 10-20 | 3 | 2 | 95 | 4.6 | 4.2 | 9.7 | 5 |
| | | 20-40 | 2 | 1 | 98 | 4.9 | 4.5 | 4.7 | 4 |
| | | 40-150 | 1 | 0 | 99 | 5.2 | 4.7 | 1.7 | 9 |
| 9 | Mixed, frigid Typic Udipsamment | 0-10 | 4 | 7 | 89 | 4.0 | 3.8 | 9.5 | 4 |
| | | 10-20 | 1 | 2 | 97 | 4.7 | 4.5 | 5.4 | 4 |
| | | 20-40 | 1 | 0 | 99 | 5.0 | 4.7 | 1.7 | 9 |
| | | 40-150 | 1 | 0 | 99 | 5.0 | 4.7 | 0.8 | 17 |

Table 4. Average seasonal pH, alkalinity, and $NO_3$, and $SO_4$ concentrations in rainwater collected in 1986 at Grand Rapids, MN

| Rainwater | pH | Alkalinity | $NO_3$ | $SO_4$ |
|---|---|---|---|---|
| | | (ueq/l) | ----(mg/l)---- | |
| Ambient | 5.7 | 24.6 | 1.4 | 1.6 |
| pH Adjusted | 5.4 | 12.0 | 2.1 | 2.9 |
| | 4.2 | -52.0 | 2.9 | 4.6 |

Table 5. Average leachate alkalinity (ueq/l) and pH values by depth (cm) and pH treatment, fall 1985-1988

| Soil depth | Year | 5.4 pH treatment | | 4.2 pH treatment | |
|---|---|---|---|---|---|
| | | Alkalinity | pH | Alkalinity | pH |
| 10 | 1985 | 9.4 [1] | 5.3 | 11.4 | 5.3 |
| | 1986 | 2.6 | 5.1 | - 8.1 | 4.9 |
| | 1987 | 5.6 | 5.2 | - 4.9 | 5.0 |
| | 1988 | - 1.1 | 5.2 | -11.0 | 5.0 |
| 20 | 1985 | 55.9 | 6.3 | 27.7 | 6.2 |
| | 1986 | 1.4 | 5.2 | - 3.2 | 5.0 |
| | 1987 | 5.0 | 5.2 | - 1.7 | 5.1 |
| | 1988 | - 2.7 | 5.2 | -10.4 | 5.0 |
| 40 | 1985 | --- | --- | --- | --- |
| | 1986 | 5.1 | 5.3 | - 0.1 | 5.2 |
| | 1987 | 5.7 | 5.3 | 1.1 | 5.2 |
| | 1988 | - 6.1 | 5.3 | - 3.2 | 5.3 |
| 150 | 1985 | 64.2 | 6.5 | 66.8 | 6.5 |
| | 1986 | 11.1 | 5.6 | 14.9 | 5.6 |
| | 1987 | 15.6 | 5.7 | 14.3 | 5.6 |
| | 1988 | 17.7 | 5.6 | 17.6 | 5.7 |

[1] Means connected by the same vertical line do not differ significantly at the .05 percent level. Tukey's HSD test.

Table 6. Average pH of leachate by treatment and depth (cm) in spring, summer, and fall of 1988

| Season | Soil depth | 5.4 pH treatment | | | | | | 4.2 pH treatment | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Litter-humus surface treatment | | | | | | Litter-humus surface treatment | | | | | |
| | | None | | Hardwood | | Jack pine | | None | | Hardwood | | Jack pine | |
| Spring | 10 | 4.9 | bc[1] | 5.2 | a | 5.1 | ab | 4.7 | c | 5.0 | ab | 4.8 | bc |
| | 20 | 5.2 | abc | 5.3 | a | 5.3 | ab | 4.9 | c | 5.1 | abc | 5.0 | bc |
| | 40 | 5.3 | a | 5.2 | a | 5.2 | a | 5.2 | a | 5.3 | a | 5.1 | a |
| | 150 | 5.9 | a | 5.9 | a | 5.7 | a | 5.8 | a | 5.9 | a | 5.8 | a |
| Summer | 10 | 4.9 | b | 5.3 | a | 5.1 | ab | 4.9 | b | 5.2 | ab | 5.0 | b |
| | 20 | 5.3 | a | 5.3 | a | 5.3 | a | 5.1 | a | 5.2 | a | 5.1 | a |
| | 40 | 5.4 | a | 5.4 | a | 5.4 | a | 5.4 | a | 5.5 | a | 5.3 | a |
| | 150 | 5.8 | a | 5.8 | a | 5.8 | a | 5.8 | a | 5.8 | a | 5.8 | a |
| Fall | 10 | 5.1 | abc | 5.2 | a | 5.2 | a | 4.9 | bc | 5.1 | ab | 4.9 | c |
| | 20 | 5.1 | ab | 5.2 | a | 5.2 | a | 4.9 | ab | 5.1 | c | 5.1 | bc |
| | 40 | 5.3 | a | 5.2 | a | 5.2 | a | 5.3 | a | 5.3 | a | 5.2 | a |
| | 150 | 5.6 | a | 5.6 | a | 5.6 | a | 5.6 | a | 5.7 | a | 5.6 | a |

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[1] Means connected by same vertical line do not differ significantly and means with same letter do not differ significantly at the .05 percent level. Tukey's HSD test.

Table 7. Average alkalinity (ueq/l) of leachate by treatment and depth (cm) in spring, summer, and fall of 1988

| Season | Soil Depth | 5.4 pH treatment | | | | | | 4.2 pH treatment | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Litter-humus surface treatment | | | | | | Litter-humus surface treatment | | | | | |
| | | None | | Hardwood | | Jack pine | | None | | Hardwood | | Jack pine | |
| Spring | 10 | -13.1 | bc[1] | 3.0 | a | 0.0 | ab | -29.2 | d | - 7.8 | abc | -18.9 | cd |
| | 20 | - 2.9 | ab | 5.6 | a | 4.4 | a | -15.5 | c | - 1.6 | ab | - 8.5 | b |
| | 40 | - 0.6 | a | - 0.2 | a | - 2.9 | a | - 5.3 | a | - 3.2 | a | - 8.7 | a |
| | 150 | 22.7 | a | 21.0 | a | 16.1 | a | 19.5 | a | 19.8 | a | 17.6 | a |
| Summer | 10 | -14.5 | bc | 4.9 | a | - 0.8 | ab | -20.7 | c | - 0.6 | ab | -12.9 | bc |
| | 20 | - 2.4 | ab | 2.2 | ab | 2.0 | a | - 9.7 | ab | - 3.4 | ab | -11.3 | b |
| | 40 | - 7.1 | a | 1.1 | a | 2.2 | a | - 4.9 | a | 5.6 | a | - 1.2 | a |
| | 150 | 20.8 | a | 27.2 | a | 20.3 | a | 16.0 | a | 23.5 | a | 18.4 | a |
| Fall | 10 | -11.6 | ab | 3.0 | a | 0.1 | a | -16.8 | b | - 4.3 | ab | -17.0 | b |
| | 20 | - 7.2 | ab | - 1.7 | a | 0.8 | a | -16.0 | b | - 6.4 | ab | - 8.7 | ab |
| | 40 | - 7.7 | a | - 9.2 | a | - 7.4 | a | - 2.7 | a | - 1.3 | a | - 4.1 | a |
| | 150 | 15.2 | a | 19.2 | a | 18.8 | a | 16.8 | a | 19.4 | a | 16.6 | a |

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[1] Means connected with same vertical line do not differ significantly and means with same letter do not differ significantly at the .05 percent level. Tukey's HSD test.

Appendix 1. Average total element concentrations for the litter-humus for each site and the three litter-humus surface treatments.

| Site-Trt. | Ca | Mg | K | Na | Al | B | Cd | Cr | Cu | Fe | Mn | Ni | Pb | Zn |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (mg/kg) | | | | | | | | | | | | | |
| 1 | 9600 | 2400 | 2800 | 120 | 10100 | 22 | 4 | 16 | 17 | 13100 | 3400 | 33 | 51 | 140 |
| 2 | 10600 | 2500 | 2800 | 110 | 10400 | 21 | 4 | 14 | 14 | 14100 | 1100 | 17 | 30 | 170 |
| 3 | 9700 | 3200 | 3300 | 200 | 13600 | 21 | 4 | 16 | 14 | 19000 | 1400 | 24 | 39 | 80 |
| 4 | 10200 | 2600 | 3200 | 160 | 12700 | 28 | 5 | 15 | 21 | 20000 | 4000 | 40 | 84 | 120 |
| 5 | 6200 | 1900 | 3400 | 100 | 6850 | 11 | 4 | 16 | 15 | 15200 | 600 | 15 | 55 | 120 |
| 6 | 5100 | 1900 | 3200 | 120 | 11000 | 14 | 4 | 13 | 16 | 13500 | 400 | 14 | 81 | 100 |
| 7 | 13500 | 2600 | 3500 | 120 | 10900 | 24 | 4 | 18 | 21 | 10700 | 2100 | 24 | 91 | 180 |
| 8 | 10600 | 2800 | 3100 | 140 | 13200 | 21 | 5 | 22 | 38 | 17500 | 1500 | 23 | 62 | 150 |
| 9 | 2900 | 1400 | 2300 | 110 | 11100 | 18 | 4 | 14 | 41 | 12300 | 300 | 14 | 103 | 150 |
| MH * | 28500 | 4900 | 4000 | 650 | 18400 | 43 | 5 | 23 | 25 | 16800 | 3600 | 48 | 58 | 280 |
| JP * | 17000 | 4000 | 4000 | 670 | 15400 | 48 | 4 | 23 | 19 | 14300 | 2500 | 32 | 52 | 220 |
| QS * | 5800 | 4600 | 2900 | 400 | 18300 | 17 | 4 | 15 | 17 | 21100 | 300 | 25 | 9 | 40 |

| Site-Trt. | AS | Ba | Be | CO | LI | MO | Sr | Ti | V |
|---|---|---|---|---|---|---|---|---|---|
| | (mg/Kg) | | | | | | | | |
| 1 | 5 | 132 | 0.4 | 5 | 5 | 4 | 51 | 760 | 32 |
| 2 | 6 | 256 | 0.4 | 5 | 6 | 4 | 69 | 780 | 32 |
| 3 | 5 | 285 | 0.4 | 6 | 9 | 5 | 68 | 640 | 26 |
| 4 | 8 | 152 | 0.5 | 6 | 6 | 5 | 62 | 930 | 42 |
| 5 | 5 | 161 | 0.3 | 4 | 4 | 4 | 33 | 730 | 32 |
| 6 | 6 | 177 | 0.4 | 4 | 6 | 5 | 32 | 780 | 30 |
| 7 | 5 | 430 | 0.4 | 5 | 5 | 4 | 82 | 900 | 32 |
| 8 | 9 | 173 | 0.5 | 6 | 6 | 5 | 63 | 1150 | 46 |
| 9 | 7 | 165 | 0.5 | 4 | 4 | 5 | 20 | 790 | 29 |
| MH * | 1 | 161 | 0.6 | 11 | 11 | 7 | 132 | 850 | 41 |
| JP * | 1 | 313 | 0.4 | 7 | 8 | 6 | 109 | 770 | 35 |
| QS * | 1 | 105 | 0.7 | 10 | 14 | 6 | 54 | 1050 | 43 |

* Mixed hardwood (MH), jack pine (JP), and quartz sand (QS) treatment caps with an established grass cover.

## APPENDIX 2. Soil profile descriptions.

Site 1
Taxonomy: Sandy, mixed, frigid Entic Haplorthod
Drainage: Somewhat excessive
Parent Materials: Glacial outwash

| | | |
|---|---|---|
| Oe | 1-0 cm | slightly decomposed leaves, twigs, and grass blades. |
| E | 0-3 cm | very dark gray (10YR 3/1) loamy sand; light brownish gray (10YR 6/2) dry: weak medium subangular blocky structure; pH 3.8; abrupt smooth boundary. |
| EB | 3-7 cm | very dark grayish brown (10YR 3/2) loamy sand; weak medium subangular blocky structure; very friable; pH 4.0; abrupt smooth boundary. |
| Bs | 7-23 cm | dark brown (7.5YR 4/4) sand with silt coatings; weak medium subangular blocky structure; very friable; pH 4.5; clear smooth boundary. |
| BC | 23-57 cm | dark yellowish brown (10YR 4/4) sand; single grain; loose; pH 4.8; clear smooth boundary. |
| C1 | 57-84 cm | yellowish brown (10YR 5/4) sand; single grain; loose; pH 5.3; clear smooth boundary. |
| C2 | 84-150 cm | brown (10YR 5/3) gravelly sand; single grain; loose; 15 percent pebbles; pH 5.2. |

Site 2
Taxonomy: Mixed, frigid Aquic Udipsamment
Drainage: Somewhat poor
Parent Material: Glacial outwash over lacustrine

| | | |
|---|---|---|
| A | 0-8 cm | black (10YR 2/1) sand; weak fine subangular blocky structure; very friable; pH 5.0; clear boundary. |
| E | 8-20 cm | very dark grayish brown (10YR 3/2) sand; light brownish gray (10YR 6/2) dry; weak fine subangular blocky structure; very friable; pH 5.4; clear boundary. |
| Bw1 | 20-30 cm | dark brown (7.5YR 4/4) sand; weak medium subangular blocky structure; very friable; pH 5.6; clear boundary. |
| Bw2 | 30-62 cm | strong brown (7.5YR 4/6) sand; single grain; loose; pH 5.8; clear boundary. |
| C | 62-82 cm | dark yellowish brown (10YR 4/4) sand; single grain, loose; pH 5.8; clear boundary. |
| Cg | 82-150 cm | brown (10YR 5/3) and dark grayish brown (10YR 4/2) stratified sand, loamy sand and sandy loam; common medium distinct strong - brown (7.5YR 5/6, 4/6) mottles; single grain and loose in sandy material and massive and very friable in sandy loam; pH 5.2. |

Site 3
Taxonomy: Mixed, frigid Aquic Udipsamment
Drainage: Moderately well
Parent Material: Glacial outwash

| | | |
|---|---|---|
| Oi | 1-0 cm | undecomposed roots from Lycopodium and leaves. |
| Ap | 0-6 cm | brown (10YR 4/3) sand; single grain; loose; this horizon appears disturbed; abrupt boundary; pH 4.9. |
| A | 6-12 cm | black (10YR 2/1) loamy sand; weak medium subangular blocky structure; very friable; pH 4.6; clear boundary. |
| Bw | 12-36 cm | brown (10YR 4/3) sand; single grain; very friable; pH 5.2; gradual boundary. |
| Bc | 36-53 cm | yellowish brown (10YR 5/4) sand; single grain; loose; Ph 5.8; gradual boundary. |
| C | 53-150 cm | light brownish gray (2.5YR 6/2) sand; few medium distinct light olive brown (2.5 Y 5/4); mottles beginning at 104 cm; single grain; loose; pH 5.6. |

Site 4
Taxonomy: Sandy, mixed, frigid Entic Haplorthod
Drainage: Somewhat excessive
Parent Material: Glacial outwash

| | | |
|---|---|---|
| A | 0-10 cm | very dark gray (10YR 3/1) sand; weak fine subangular blocky structure; very friable; pH 4.1; clear smooth boundary. |
| Bs | 10-40 cm | dark yellowish brown (10YR 3/4) sand with silt coatings; weak medium subangular blocky structure; very friable; pH 4.8; clear smooth boundary. |
| BC | 40-70 cm | dark brown (7.5YR 4/4) sand; single grain; loose; pH 5.3; gradual boundary. |
| C | 70-150 cm | dark brown (7.5YR 4/4) sand; single grain; loose; pH 5.4. |

Site 5
Taxonomy: Mixed, frigid Typic Udipsamment
Drainage: Moderately well
Parent Material: Glacial outwash

| | | |
|---|---|---|
| A | 0-15 cm | dark brown (7.5YR 3/2) sand; single grain; loose; pH 4.3; abrupt smooth boundary. |
| Bs | 15-27 cm | dark brown (7.5YR 4/4) sand; single grain; loose; pH 4.8. |
| BC | 27-60 cm | dark brown (7.5YR 4/4) sand; single grain; loose; pH 5.2. |
| C1 | 60-110 cm | brown (7.5YR 5/4) sand; loose; pH 5.3. |
| C2 | 110-150 cm | dark brown (7.5YR 4/4); few fine distinct strong brown (7.5YR 5/6) mottles above a band of higher silt content sand; single grain; loose; pH 5.4. |

Site 6
Taxonomy: Mixed, frigid Typic Udipsamment
Drainage: Somewhat excessive
Parent Material: Glacial outwash

| | | |
|---|---|---|
| Ap | 0-15 cm | dark brown (7.5YR 3/2) sand; single grain; loose; pH 4.8; abrupt boundary. |
| B1 | 15-40 cm | dark brown (7.5YR 4/4) sand; single grain; pH 5.0; gradual boundary. |
| Bs2 | 40-60 cm | brown (7.5YR 4/4) sand; single grain; loose; pH 5.1; clear boundary. |
| BC | 60-84 cm | brown (7.5YR 5/4) sand; single grain; loose; pH 5.2. |
| C | 84-150 cm | brown (7.5YR 5/4) sand; single grain; loose; pH 5.3 |

Site 7
Taxonomy: Sandy, mixed, frigid Entic Haplorthod
Drainage: Moderately well
Parent Material: Glacial outwash

| | | |
|---|---|---|
| Oe | 5-4 cm | slightly decomposed organic matter; abrupt smooth boundary. |
| Oa | 4-0 cm | decomposed organic matter; abrupt smooth boundary. |
| E | 0-5 cm | very dark grayish brown (10YR 3/2) loamy fine sand; pinkish gray (7.5YR 6/2) dry; weak fine subangular blocky; very friable; pH 4.6; abrupt smooth boundary. |
| B1 | 5-15 cm | dark brown (7.5YR 3/4) loamy fine sand with cracked silt coatings; weak medium subangular blocky; very friable; pH 4.3; smooth boundary. |
| Bs2 | 15-37 cm | dark brown (7.5YR 4/4) loamy fine sand; weak medium subangular blocky; very friable; pH 5.0. |
| BC | 37-58 cm | brown (7.5YR 4/4) fine sand; single grain; loose; pH 5.2. |
| C1 | 58-87 cm | brown (7.5YR 5/4) loamy fine sand; massive; very friable; pH 5.3. |
| C2 | 87-150 cm | brown (7.5YR 5/4) loamy fine sand; massive; very friable; pH 5.1. |

Site 8
Taxonomy: Mixed, frigid Spodic Udipsamment
Drainage: Somewhat excessive
Parent Material: Glacial outwash

| | | |
|---|---|---|
| Oi | 1-0 cm | undecomposed leaves and roots; abrupt smooth boundary. |
| E | 0-12 cm | dark brown (7.5YR 4/2) sand; single grain; loose; pH 4.3; clear smooth boundary. |
| Bs | 12-37 cm | dark brown (7.5YR 4/4, 3/4) sand; single grain; loose; pH 4.8; clear smooth boundary. |
| BC | 37-90 cm | brown (7.5YR 4/4) sand; single grain; loose; pH 5.0; abrupt smooth boundary. |
| C | 90-150 cm | brown (7.5YR 5/4) sand; single grain; loose; pH 5.3. |

Site 9
Taxonomy: Mixed, frigid Typic Udipsamment
Drainage: Somewhat excessive
Parent Material: Glacial outwash

| | | |
|---|---|---|
| Oe | 1-0 cm | slightly decomposed organic matter of roots and leaves; abrupt smooth boundary. |
| A | 0-2 cm | dark brown (7.5YR 3/2) loamy sand; weak fine subangular blocky structure; loose; pH 3.8; clear wavy boundary. |
| Bw | 2-17 cm | dark yellowish brown (10YR 4/4) sand; single grain; loose; pH 4.4; clear wavy boundary. |
| BC1 | 17-38 cm | yellowish brown (10YR 5/4) sand; single grain; loose; pH 4.9; clear wavy boundary. |
| BC2 | 38-54 cm | brown (7.5YR 5/4) sand; single grain; loose; pH 5.1. |
| C | 54-150 cm | pinkish gray (7.5YR 6/2) sand; loose; pH 5.1. |

Appendix 3. Particle size analyses, bulk density, and water content by depth. Site 1

| Soil depth | Clay | Silt | Sand | | | | | | Total > 2mm | Bulk density | Water content |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | vfs | fs | ms | cs | vcs | total | | | |
| (cm) | - - - | - - - | - - - | - - - | -(%)- | - - - | - - - | - - - | - - - | gms/cm$^3$ | % vol |
| 0-5 | 3 | 12 | 3 | 28 | 51 | 4 | 0 | 86 | 1 | .77 | 15 |
| 5-10 | 5 | 10 | 2 | 27 | 48 | 5 | 0 | 85 | 6 | 1.13 | 13 |
| 10-15 | 4 | 9 | 4 | 29 | 51 | 5 | 0 | 88 | 2 | 1.05 | 13 |
| 15-20 | 3 | 8 | 3 | 31 | 54 | 4 | 0 | 89 | 2 | 1.14 | 11 |
| 20-25 | 3 | 8 | 3 | 28 | 51 | 4 | 0 | 89 | 4 | 1.25 | 11 |
| 25-30 | 3 | 8 | 3 | 29 | 51 | 4 | 0 | 89 | 5 | 1.36 | 11 |
| 30-35 | 2 | 7 | 3 | 28 | 56 | 4 | 0 | 91 | 3 | 1.37 | 11 |
| 35-40 | 2 | 7 | 3 | 27 | 55 | 4 | 0 | 91 | 4 | 1.41 | 10 |
| 40-45 | 3 | 5 | 4 | 28 | 54 | 5 | 0 | 93 | 1 | 1.32 | 10 |
| 45-50 | 2 | 6 | 3 | 59 | 55 | 3 | 0 | 93 | <1 | 1.40 | 10 |
| 50-55 | 1 | 4 | 4 | 32 | 53 | 4 | 0 | 95 | <1 | 1.48 | 10 |
| 55-60 | 1 | 3 | 4 | 31 | 54 | 5 | 0 | 96 | <1 | 1.39 | 8 |
| 60-65 | 1 | 0 | 2 | 17 | 64 | 16 | 0 | 99 | 1 | 1.45 | 6 |
| 65-70 | 1 | 1 | 1 | 11 | 64 | 23 | 0 | 99 | 9 | 1.67 | 5 |
| 70-75 | 0 | 1 | 1 | 10 | 69 | 19 | 0 | 99 | 7 | 1.53 | 7 |
| 75-80 | 0 | 1 | 1 | 10 | 63 | 25 | 0 | 99 | 7 | 1.51 | 6 |
| 80-85 | 0 | 0 | 1 | 8 | 49 | 41 | 0 | 99 | 13 | 1.64 | 7 |
| 85-90 | 0 | 0 | 1 | 10 | 44 | 44 | 0 | 100 | 19 | 1.60 | 6 |
| 90-95 | 0 | 0 | 1 | 15 | 48 | 35 | 0 | 100 | 20 | 1.51 | 6 |
| 95-100 | 0 | 0 | 1 | 11 | 44 | 44 | 0 | 100 | 24 | 1.61 | 5 |
| 100-105 | 1 | 1 | 1 | 10 | 42 | 46 | 0 | 99 | 27 | 1.66 | 6 |
| 105-110 | 1 | 0 | 1 | 13 | 54 | 31 | 0 | 99 | 19 | 1.50 | 7 |
| 110-115 | 0 | 1 | 1 | 14 | 45 | 38 | 0 | 99 | 48 | 1.63 | 10 |
| 115-120 | 0 | 0 | 1 | 20 | 58 | 19 | 0 | 100 | 10 | 1.75 | 11 |
| 120-125 | 0 | 0 | 1 | 11 | 43 | 44 | 1 | 100 | 31 | 1.51 | 13 |
| 125-130 | 0 | 0 | 1 | 19 | 53 | 26 | 0 | 100 | 21 | 1.70 | 17 |
| 130-135 | 0 | 0 | 1 | 15 | 57 | 27 | 0 | 100 | 22 | 1.56 | 14 |
| 135-140 | 0 | 0 | 1 | 19 | 52 | 26 | 0 | 100 | 18 | 1.70 | 20 |
| 140-145 | 0 | 0 | 1 | 18 | 54 | 26 | 0 | 100 | 22 | 1.70 | 24 |

Appendix 3. (Continued). Site 2

| Soil depth | Clay | Silt | Sand | | | | | | Total > 2mm | Bulk density | Water content |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | vfs | fs | ms | cs | vcs | total | | | |
| (cm) | - - - | - - - | - - - | - - - | -(%)- | - - - | - - - | - - - | - - - | gms/cm$^3$ | % vol |
| 0-5 | 3 | 8 | 1 | 21 | 57 | 10 | 0 | 89 | <1 | 1.17 | 18 |
| 5-10 | 3 | 8 | 1 | 22 | 56 | 10 | 0 | 89 | <1 | 1.40 | 15 |
| 10-15 | 4 | 7 | 1 | 21 | 54 | 9 | 0 | 89 | <1 | 1.41 | 14 |
| 15-20 | 4 | 7 | 2 | 22 | 59 | 10 | 0 | 89 | <1 | 1.38 | 13 |
| 20-25 | 5 | 6 | 1 | 22 | 60 | 11 | 0 | 90 | <1 | 1.34 | 14 |
| 25-30 | 5 | 5 | 1 | 21 | 55 | 9 | 0 | 90 | <1 | 1.39 | 14 |
| 30-35 | 4 | 5 | 1 | 21 | 56 | 10 | 0 | 92 | <1 | 1.33 | 12 |
| 35-40 | 3 | 3 | 1 | 21 | 58 | 11 | 0 | 94 | <1 | 1.45 | 12 |
| 40-45 | 2 | 4 | 2 | 25 | 56 | 10 | 0 | 94 | 1 | 1.51 | 11 |
| 45-50 | 2 | 5 | 2 | 25 | 55 | 10 | 0 | 94 | 1 | 1.42 | 9 |
| 50-55 | 2 | 4 | 1 | 25 | 54 | 10 | 0 | 94 | 1 | 1.48 | 10 |
| 55-60 | 2 | 3 | 1 | 23 | 58 | 12 | 0 | 95 | <1 | 1.48 | 9 |
| 60-65 | 2 | 3 | 1 | 24 | 58 | 12 | 0 | 95 | 1 | 1.60 | 9 |
| 65-70 | 2 | 2 | 1 | 22 | 60 | 13 | 0 | 97 | 1 | 1.54 | 8 |
| 70-75 | 2 | 1 | 1 | 20 | 62 | 14 | 0 | 97 | 1 | 1.50 | 7 |
| 75-80 | 2 | 2 | 1 | 22 | 59 | 16 | 0 | 97 | 1 | 1.42 | 6 |
| 80-85 | 2 | 2 | 2 | 24 | 55 | 14 | 0 | 96 | 1 | 1.51 | 7 |
| 85-90 | 3 | 6 | 4 | 32 | 46 | 10 | 0 | 91 | 1 | 1.46 | 12 |
| 90-95 | 7 | 16 | 5 | 25 | 38 | 7 | 0 | 78 | 1 | 1.51 | 17 |
| 95-100 | 4 | 10 | 6 | 30 | 40 | 13 | 0 | 87 | 2 | 1.40 | 16 |
| 100-105 | 2 | 6 | 4 | 35 | 40 | 9 | 0 | 92 | 1 | 1.50 | 16 |
| 105-110 | 3 | 5 | 4 | 30 | 47 | 9 | 0 | 93 | 1 | 1.54 | 16 |
| 110-115 | 4 | 9 | 4 | 27 | 43 | 11 | 0 | 87 | 1 | 1.50 | 18 |
| 115-120 | 2 | 4 | 3 | 27 | 51 | 12 | 0 | 94 | 2 | 1.42 | 17 |
| 120-125 | 4 | 10 | 4 | 26 | 44 | 10 | 0 | 87 | 2 | 1.60 | 22 |
| 125-130 | 6 | 15 | 5 | 25 | 41 | 9 | 0 | 79 | 1 | 1.58 | 25 |
| 130-135 | 7 | 21 | 6 | 22 | 35 | 8 | 0 | 71 | <1 | 1.69 | 26 |
| 135-140 | 5 | 13 | 5 | 24 | 41 | 12 | 0 | 82 | 1 | 1.70 | 25 |
| 140-145 | 5 | 9 | 3 | 22 | 50 | 15 | 0 | 86 | 1 | 1.65 | 25 |
| 145-150 | 5 | 14 | 5 | 27 | 42 | 10 | 0 | 81 | 1 | 1.59 | 24 |

Appendix 3. (Continued). Site 3

| Soil depth | Clay | Silt | Sand | | | | | | Total > 2mm | Bulk density | Water content |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | vfs | fs | ms | cs | vcs | total | | | |
| (cm) | | | | | (%) | | | | | gms/cm$^3$ | % vol |
| 0-5 | 4 | 8 | 1 | 36 | 52 | 2 | 0 | 88 | <1 | .76 | 16 |
| 5-10 | 4 | 9 | 1 | 37 | 48 | 1 | 0 | 87 | <1 | 1.06 | 18 |
| 10-15 | 5 | 7 | 1 | 34 | 48 | 1 | 0 | 88 | <1 | 1.14 | 15 |
| 15-20 | 4 | 6 | 2 | 39 | 50 | 1 | 0 | 90 | <1 | 1.24 | 15 |
| 20-25 | 3 | 4 | 2 | 40 | 52 | 1 | 0 | 92 | <1 | 1.19 | 12 |
| 25-30 | 3 | 4 | 2 | 36 | 50 | 1 | 0 | 93 | <1 | 1.37 | 10 |
| 30-35 | 3 | 3 | 2 | 36 | 53 | 1 | 0 | 94 | 1 | 1.38 | 8 |
| 35-40 | 2 | 3 | 3 | 42 | 49 | 1 | 0 | 95 | 1 | 1.38 | 7 |
| 40-45 | 2 | 2 | 2 | 44 | 48 | 1 | 0 | 96 | <1 | 1.36 | 6 |
| 45-50 | 2 | 1 | 3 | 43 | 49 | 1 | 0 | 97 | <1 | 1.38 | 5 |
| 50-55 | 2 | 1 | 3 | 47 | 47 | 1 | 0 | 97 | <1 | 1.43 | 5 |
| 55-60 | 1 | 1 | 2 | 47 | 48 | 1 | 0 | 98 | <1 | 1.42 | 5 |
| 60-65 | 1 | 1 | 3 | 45 | 49 | 1 | 0 | 98 | <1 | 1.35 | 4 |
| 65-70 | 1 | 1 | 3 | 46 | 47 | 1 | 0 | 98 | <1 | 1.38 | 5 |
| 70-75 | 1 | 1 | 3 | 43 | 50 | 2 | 0 | 98 | <1 | 1.42 | 6 |
| 75-80 | 1 | 1 | 3 | 42 | 53 | 1 | 0 | 98 | <1 | 1.39 | 6 |
| 80-85 | 1 | 1 | 2 | 47 | 47 | 1 | 0 | 98 | <1 | 1.40 | 6 |
| 85-90 | 1 | 0 | 3 | 45 | 49 | 1 | 0 | 99 | <1 | 1.40 | 8 |
| 90-95 | 1 | 1 | 3 | 43 | 51 | 1 | 0 | 99 | <1 | 1.36 | 8 |
| 95-100 | 1 | 1 | 3 | 46 | 49 | 1 | 0 | 99 | <1 | 1.31 | 7 |
| 100-105 | 2 | 0 | 3 | 47 | 47 | 1 | 0 | 98 | <1 | 1.35 | 9 |
| 105-110 | 2 | 0 | 3 | 46 | 49 | 1 | 0 | 98 | <1 | 1.37 | 10 |
| 110-115 | 2 | 0 | 2 | 39 | 56 | 1 | 0 | 98 | <1 | 1.40 | 10 |
| 115-120 | 1 | 0 | 3 | 44 | 50 | 1 | 0 | 99 | <1 | 1.39 | 10 |
| 120-125 | 2 | 0 | 2 | 44 | 50 | 1 | 0 | 99 | <1 | 1.42 | 12 |
| 125-130 | 2 | 0 | 3 | 47 | 46 | 1 | 0 | 98 | <1 | 1.39 | 14 |
| 130-135 | 1 | 0 | 2 | 46 | 49 | 1 | 0 | 99 | <1 | 1.49 | 14 |
| 135-140 | 2 | 0 | 3 | 45 | 49 | 1 | 0 | 99 | <1 | 1.46 | 22 |
| 140-145 | 2 | 0 | 2 | 47 | 49 | 0 | 0 | 98 | <1 | 1.14 | 19 |

Appendix 3. (Continued). Site 4

| Soil depth | Clay | Silt | Sand | | | | | | Total > 2mm | Bulk density | Water content |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | vfs | fs | ms | cs | vcs | total | | | |
| (cm) | | | | | (%) | | | | | gms/cm$^3$ | % vol |
| 0-5 | 4 | 9 | 7 | 38 | 32 | 9 | 0 | 88 | <1 | 1.05 | 10 |
| 5-10 | 4 | 9 | 8 | 38 | 33 | 9 | 0 | 87 | <1 | 1.10 | 11 |
| 10-15 | 5 | 9 | 9 | 42 | 31 | 8 | 0 | 87 | <1 | 1.30 | 13 |
| 15-20 | 4 | 9 | 9 | 40 | 32 | 8 | 0 | 87 | <1 | 1.33 | 11 |
| 20-25 | 3 | 9 | 11 | 40 | 27 | 7 | 0 | 88 | <1 | 1.30 | 11 |
| 25-30 | 2 | 7 | 13 | 43 | 25 | 5 | 0 | 91 | <1 | 1.41 | 10 |
| 30-35 | 2 | 6 | 13 | 43 | 25 | 6 | 0 | 92 | <1 | 1.40 | 7 |
| 35-40 | 3 | 4 | 13 | 45 | 26 | 6 | 0 | 93 | <1 | 1.43 | 6 |
| 40-45 | 1 | 6 | 11 | 45 | 27 | 6 | 0 | 93 | <1 | 1.48 | 5 |
| 45-50 | 1 | 5 | 12 | 44 | 29 | 6 | 0 | 94 | <1 | 1.50 | 5 |
| 50-55 | 1 | 5 | 12 | 42 | 32 | 7 | 0 | 94 | <1 | 1.46 | 4 |
| 55-60 | 1 | 5 | 11 | 41 | 33 | 8 | 0 | 94 | <1 | 1.55 | 6 |
| 60-65 | 1 | 5 | 9 | 40 | 35 | 7 | 0 | 93 | <1 | 1.49 | 7 |
| 65-70 | 3 | 4 | 9 | 38 | 37 | 8 | 0 | 93 | <1 | 1.52 | 9 |
| 70-75 | 2 | 4 | 8 | 37 | 38 | 8 | 0 | 94 | <1 | 1.50 | 12 |
| 75-80 | 2 | 5 | 10 | 37 | 37 | 8 | 0 | 93 | <1 | 1.57 | 15 |
| 80-85 | 2 | 3 | 10 | 44 | 34 | 5 | 0 | 95 | <1 | 1.50 | 14 |
| 85-90 | 2 | 4 | 12 | 45 | 32 | 4 | 0 | 95 | <1 | 1.53 | 16 |
| 90-95 | 2 | 5 | 12 | 42 | 35 | 5 | 0 | 93 | <1 | 1.49 | 15 |
| 95-100 | 2 | 2 | 11 | 49 | 32 | 4 | 0 | 96 | <1 | 1.56 | 16 |
| 100-105 | 2 | 4 | 10 | 45 | 35 | 4 | 0 | 94 | <1 | 1.50 | 18 |
| 105-110 | 1 | 5 | 10 | 43 | 35 | 5 | 0 | 94 | <1 | 1.54 | 19 |
| 110-115 | 1 | 4 | 10 | 41 | 38 | 6 | 0 | 95 | <1 | 1.57 | 21 |
| 115-120 | 2 | 2 | 10 | 43 | 37 | 7 | 0 | 96 | <1 | 1.58 | 21 |
| 120-125 | 1 | 4 | 11 | 43 | 35 | 6 | 0 | 95 | <1 | 1.72 | 24 |
| 125-130 | 1 | 4 | 10 | 43 | 36 | 5 | 0 | 95 | <1 | 1.95 | 23 |

Appendix 3. (Continued). Site 5

| Soil depth | Clay | Silt | Sand | | | | | | Total > 2mm | Bulk density | Water content |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | vfs | fs | ms | cs | vcs | total | | | |
| (cm) | | | | | -(%)- | | | | | gms/cm$^3$ | % vol |
| 0-5 | 4 | 3 | 2 | 23 | 55 | 16 | 0 | 93 | 1 | 1.23 | 14 |
| 5-10 | 4 | 3 | 2 | 22 | 51 | 15 | 0 | 93 | 1 | 1.36 | 13 |
| 10-15 | 5 | 3 | 2 | 22 | 51 | 15 | 0 | 92 | 1 | 1.40 | 14 |
| 15-20 | 5 | 2 | 2 | 22 | 49 | 15 | 0 | 93 | 4 | 1.46 | 13 |
| 20-25 | 4 | 2 | 2 | 23 | 51 | 16 | 0 | 94 | 5 | 1.49 | 12 |
| 25-30 | 4 | 1 | 2 | 21 | 48 | 24 | 0 | 96 | 5 | 1.57 | 9 |
| 30-35 | 3 | 0 | 1 | 18 | 49 | 28 | 0 | 97 | 7 | 1.59 | 6 |
| 35-40 | 3 | 0 | 1 | 16 | 59 | 24 | 0 | 98 | 5 | 1.58 | 5 |
| 40-45 | 3 | 0 | 1 | 18 | 67 | 13 | 0 | 98 | 2 | 1.59 | 6 |
| 45-50 | 2 | 0 | 1 | 18 | 69 | 11 | 0 | 98 | <1 | 1.69 | 6 |
| 50-55 | 2 | 0 | 1 | 17 | 62 | 19 | 0 | 98 | 1 | 1.47 | 4 |
| 55-60 | 2 | 0 | 1 | 19 | 62 | 17 | 0 | 99 | 3 | 1.57 | 5 |
| 60-65 | 2 | 0 | 2 | 21 | 58 | 18 | 0 | 99 | 4 | 1.46 | 4 |
| 65-70 | 1 | 0 | 3 | 27 | 54 | 15 | 0 | 99 | 1 | 1.53 | 5 |
| 70-75 | 2 | 0 | 4 | 32 | 51 | 12 | 0 | 99 | 3 | 1.47 | 5 |
| 75-80 | 2 | 0 | 4 | 30 | 51 | 15 | 0 | 98 | 5 | 1.51 | 5 |
| 80-85 | 2 | 0 | 2 | 28 | 53 | 15 | 0 | 98 | 2 | 1.49 | 6 |
| 85-90 | 2 | 0 | 3 | 30 | 53 | 13 | 0 | 97 | 3 | 1.52 | 6 |
| 90-95 | 2 | 1 | 5 | 29 | 50 | 14 | 0 | 96 | 2 | 1.46 | 8 |
| 95-100 | 3 | 3 | 6 | 29 | 45 | 14 | 0 | 94 | 3 | 1.46 | 11 |
| 100-105 | 2 | 2 | 5 | 28 | 51 | 14 | 0 | 97 | 2 | 1.54 | 10 |
| 105-110 | 2 | 1 | 3 | 26 | 50 | 20 | 0 | 97 | 5 | 1.56 | 11 |
| 110-115 | 2 | 3 | 5 | 24 | 47 | 20 | 0 | 94 | 3 | 1.53 | 14 |
| 115-120 | 2 | 5 | 7 | 26 | 45 | 15 | 0 | 93 | 1 | 1.55 | 18 |
| 120-125 | 2 | 9 | 8 | 29 | 34 | 14 | 0 | 90 | 1 | 1.52 | 22 |
| 125-130 | 2 | 6 | 8 | 27 | 38 | 18 | 0 | 92 | 2 | 1.62 | 24 |
| 130-135 | 1 | 7 | 4 | 25 | 47 | 19 | 0 | 92 | 2 | 1.66 | 24 |

Appendix 3. (Continued). Site 6

| Soil depth | Clay | Silt | Sand | | | | | | Total > 2mm | Bulk density | Water content |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | vfs | fs | ms | cs | vcs | total | | | |
| (cm) | | | | | -(%)- | | | | | gms/cm$^3$ | % vol |
| 0-5 | 4 | 5 | 4 | 46 | 40 | 6 | 0 | 92 | 1 | 1.12 | 15 |
| 5-10 | 5 | 5 | 3 | 40 | 41 | 8 | 0 | 91 | <1 | 1.34 | 12 |
| 10-15 | 5 | 3 | 3 | 41 | 43 | 8 | 0 | 92 | 1 | 1.33 | 12 |
| 15-20 | 4 | 4 | 3 | 41 | 38 | 7 | 0 | 92 | 1 | 1.24 | 12 |
| 20-25 | 5 | 3 | 3 | 42 | 41 | 8 | 0 | 92 | <1 | 1.36 | 12 |
| 25-30 | 3 | 5 | 3 | 42 | 39 | 7 | 0 | 92 | 1 | 1.31 | 10 |
| 30-35 | 4 | 5 | 3 | 42 | 36 | 7 | 0 | 92 | 1 | 1.48 | 10 |
| 35-40 | 4 | 3 | 3 | 45 | 38 | 7 | 0 | 93 | 1 | 1.33 | 8 |
| 40-45 | 2 | 4 | 3 | 44 | 37 | 6 | 0 | 94 | 1 | 1.31 | 7 |
| 45-50 | 2 | 4 | 4 | 45 | 38 | 6 | 0 | 94 | 2 | 1.41 | 7 |
| 50-55 | 2 | 5 | 3 | 45 | 38 | 6 | 0 | 93 | 1 | 1.41 | 7 |
| 55-60 | 1 | 4 | 2 | 47 | 38 | 6 | 1 | 95 | 3 | 1.49 | 7 |
| 60-65 | 2 | 3 | 3 | 50 | 35 | 4 | 0 | 95 | 3 | 1.41 | 7 |
| 65-70 | 1 | 5 | 3 | 53 | 35 | 4 | 0 | 95 | <1 | 1.36 | 7 |
| 70-75 | 2 | 2 | 3 | 56 | 33 | 3 | 0 | 96 | <1 | 1.36 | 7 |
| 75-80 | 2 | 2 | 3 | 54 | 36 | 2 | 0 | 97 | 3 | 1.37 | 8 |
| 80-85 | 2 | 0 | 3 | 50 | 38 | 4 | 0 | 98 | 1 | 1.37 | 8 |
| 85-90 | 2 | 0 | 2 | 40 | 41 | 10 | 0 | 98 | 2 | 1.33 | 10 |
| 90-95 | 1 | 0 | 4 | 43 | 44 | 11 | 0 | 99 | 3 | 1.35 | 11 |
| 95-100 | 1 | 0 | 4 | 48 | 42 | 10 | 0 | 99 | 2 | 1.40 | 13 |
| 100-105 | 2 | 0 | 3 | 51 | 39 | 5 | 0 | 99 | 1 | 1.32 | 16 |
| 105-110 | 1 | 0 | 3 | 50 | 41 | 3 | 0 | 100 | <1 | 1.37 | 19 |
| 110-115 | 2 | 0 | 3 | 42 | 45 | 7 | 0 | 99 | 1 | 1.38 | 21 |
| 115-120 | 1 | 0 | 4 | 45 | 46 | 7 | 0 | 99 | 2 | 1.48 | 27 |
| 120-125 | 1 | 0 | 4 | 45 | 41 | 7 | 0 | 99 | 2 | 1.52 | 26 |

Appendix 3. (Continued). Site 7

| Soil depth | Clay | Silt | Sand | | | | | | Total > 2mm | Bulk density | Water content |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | vfs | fs | ms | cs | vcs | total | | | |
| (cm) | - - - | - - - | - - - | - - - | -(%)- | - - - | - - - | - - - | - - - | gms/cm$^3$ | % vol |
| 0-5 | - | -- | -- | -- | -- | - | - | - | 3 | .55 | 34 |
| 5-10 | 6 | 19 | 11 | 46 | 18 | 3 | 0 | 75 | <1 | 1.15 | 28 |
| 10-15 | 7 | 16 | 14 | 46 | 17 | 3 | 0 | 77 | <1 | 1.11 | 30 |
| 15-20 | 4 | 13 | 14 | 49 | 19 | 3 | 0 | 83 | 1 | 1.18 | 30 |
| 20-25 | 4 | 13 | 19 | 44 | 16 | 3 | 0 | 84 | 1 | 1.31 | 31 |
| 25-30 | 4 | 13 | 19 | 47 | 16 | 3 | 0 | 84 | <1 | 1.39 | 29 |
| 30-35 | 4 | 12 | 21 | 48 | 14 | 3 | 0 | 84 | 1 | 1.39 | 27 |
| 35-40 | 3 | 12 | 25 | 47 | 11 | 2 | 0 | 85 | <1 | 1.48 | 27 |
| 40-45 | 3 | 9 | 24 | 55 | 9 | 2 | 0 | 89 | <1 | 1.49 | 25 |
| 45-50 | 2 | 6 | 33 | 52 | 8 | 2 | 0 | 92 | <1 | 1.48 | 25 |
| 50-55 | 2 | 6 | 30 | 46 | 11 | 2 | 1 | 93 | <1 | 1.48 | 24 |
| 55-60 | 2 | 5 | 25 | 47 | 17 | 3 | 0 | 93 | <1 | 1.53 | 22 |
| 60-65 | 2 | 7 | 25 | 42 | 18 | 5 | 1 | 91 | <1 | 1.59 | 27 |
| 65-70 | 2 | 9 | 27 | 38 | 17 | 7 | 0 | 90 | 1 | 1.59 | 29 |
| 70-75 | 2 | 11 | 33 | 38 | 11 | 4 | 0 | 88 | <1 | 1.65 | 34 |
| 75-80 | 1 | 15 | 37 | 41 | 6 | 1 | 0 | 84 | <1 | 1.57 | 31 |
| 80-85 | 1 | 15 | 43 | 37 | 5 | 1 | 0 | 84 | <1 | 1.44 | 36 |
| 85-90 | 0 | 10 | 41 | 44 | 5 | 0 | 0 | 90 | <1 | 1.45 | 37 |
| 90-95 | 1 | 11 | 44 | 42 | 4 | 0 | 0 | 88 | <1 | 1.43 | 36 |
| 95-100 | 2 | 13 | 37 | 45 | 3 | 0 | 0 | 86 | <1 | 1.25 | 21 |
| 100-105 | 2 | 12 | 45 | 43 | 2 | 0 | 0 | 87 | <1 | 1.27 | 26 |
| 105-110 | 1 | 7 | 42 | 48 | 2 | 0 | 0 | 92 | <1 | 1.26 | 23 |
| 110-115 | 0 | 14 | 49 | 38 | 2 | 0 | 0 | 86 | <1 | 1.29 | 26 |
| 115-120 | 2 | 10 | 50 | 38 | 2 | 0 | 0 | 89 | <1 | 1.31 | 26 |
| 120-125 | 2 | 6 | 39 | 52 | 2 | 0 | 0 | 93 | <1 | 1.33 | 25 |
| 125-130 | 2 | 12 | 48 | 39 | 2 | 0 | 0 | 86 | <1 | 1.40 | 28 |
| 130-135 | 1 | 7 | 33 | 55 | 2 | 0 | 0 | 92 | <1 | 1.36 | 27 |
| 135-140 | 2 | 15 | 42 | 38 | 2 | 0 | 0 | 84 | <1 | 1.35 | 29 |
| 140-145 | 1 | 15 | 36 | 43 | 2 | 0 | 0 | 84 | <1 | 1.45 | 33 |
| 145-150 | 1 | 17 | 37 | 34 | 8 | 2 | 0 | 83 | 1 | 1.44 | 34 |

Appendix 3. (Continued). Site 8

| Soil depth | Clay | Silt | Sand | | | | | | Total > 2mm | Bulk density | Water content |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | vfs | fs | ms | cs | vcs | total | | | |
| (cm) | - - - | - - - | - - - | - - - | -(%)- | - - - | - - - | - - - | - - - | gms/cm$^3$ | % vol |
| 0-5 | 4 | 7 | 5 | 36 | 42 | 6 | 0 | 90 | 2 | .88 | 21 |
| 5-10 | 4 | 4 | 5 | 41 | 45 | 5 | 0 | 92 | 5 | 1.07 | 15 |
| 10-15 | 4 | 3 | 6 | 41 | 42 | 3 | 0 | 93 | 3 | 1.21 | 21 |
| 15-20 | 3 | 1 | 3 | 42 | 48 | 3 | 0 | 97 | 1 | 1.23 | 13 |
| 20-25 | 2 | 0 | 3 | 40 | 52 | 2 | 0 | 98 | <1 | 1.30 | 11 |
| 25-30 | 2 | 1 | 3 | 46 | 47 | 2 | 0 | 97 | <1 | 1.40 | 10 |
| 30-35 | 2 | 0 | 3 | 43 | 50 | 3 | 0 | 98 | <1 | 1.36 | 10 |
| 35-40 | 2 | 1 | 1 | 33 | 58 | 5 | 0 | 98 | 1 | 1.47 | 10 |
| 40-45 | 2 | 1 | 1 | 34 | 57 | 6 | 0 | 97 | 1 | 1.43 | 10 |
| 45-50 | 2 | 1 | 2 | 40 | 54 | 3 | 0 | 97 | <1 | 1.41 | 10 |
| 50-55 | 2 | 1 | 3 | 40 | 53 | 2 | 0 | 98 | <1 | 1.50 | 10 |
| 55-60 | 3 | 0 | 2 | 41 | 54 | 2 | 0 | 98 | <1 | 1.43 | 9 |
| 60-65 | 1 | 0 | 2 | 40 | 55 | 2 | 0 | 99 | <1 | 1.56 | 10 |
| 65-70 | 1 | 0 | 2 | 40 | 56 | 2 | 0 | 99 | <1 | 1.54 | 8 |
| 70-75 | 1 | 0 | 2 | 41 | 55 | 2 | 0 | 99 | <1 | 1.47 | 8 |
| 75-80 | 1 | 1 | 2 | 39 | 56 | 2 | 0 | 98 | <1 | 1.47 | 9 |
| 80-85 | 1 | 0 | 2 | 43 | 52 | 2 | 0 | 99 | <1 | 1.55 | 10 |
| 85-90 | 1 | 0 | 3 | 45 | 49 | 2 | 0 | 99 | <1 | 1.49 | 9 |
| 90-95 | 1 | 0 | 3 | 44 | 50 | 3 | 0 | 99 | <1 | 1.37 | 9 |
| 95-100 | 1 | 0 | 2 | 38 | 56 | 5 | 0 | 99 | <1 | 1.45 | 9 |
| 100-105 | 0 | 0 | 2 | 37 | 57 | 4 | 0 | 99 | <1 | 1.41 | 11 |
| 105-110 | 1 | 0 | 2 | 44 | 50 | 3 | 0 | 99 | <1 | 1.47 | 14 |
| 110-115 | 1 | 0 | 2 | 41 | 54 | 4 | 0 | 99 | <1 | 1.45 | 15 |
| 115-120 | 1 | 0 | 1 | 39 | 55 | 4 | 0 | 99 | <1 | 1.46 | 17 |
| 120-125 | 1 | 0 | 2 | 42 | 51 | 3 | 0 | 99 | <1 | 1.43 | 17 |
| 125-130 | 1 | 0 | 2 | 43 | 51 | 4 | 0 | 99 | <1 | 1.42 | 18 |
| 130-135 | 1 | 0 | 2 | 40 | 54 | 3 | 0 | 99 | 1 | 1.51 | 21 |
| 135-140 | 1 | 1 | 1 | 38 | 57 | 3 | 0 | 99 | <1 | 1.58 | 32 |
| 140-145 | 0 | 0 | 3 | 43 | 51 | 3 | 0 | 100 | <1 | .57 | 15 |

Appendix 3. (Continued). Site 9

| Soil depth | Clay | Silt | Sand | | | | | | Total > 2mm | Bulk density | Water content |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | vfs | fs | ms | cs | vcs | total | | | |
| (cm) | - - - | - - - | - - - | - - - | - - -(%)- - - | - - - | - - - | - - - | - - - | gms/cm$^3$ | % vol |
| 0-5 | 5 | 11 | 5 | 37 | 41 | 3 | 0 | 85 | <1 | 1.01 | 17 |
| 5-10 | 3 | 3 | 4 | 37 | 46 | 4 | 0 | 94 | <1 | 1.31 | 15 |
| 10-15 | 2 | 3 | 3 | 38 | 49 | 5 | 0 | 96 | <1 | 1.36 | 13 |
| 15-20 | 1 | 1 | 2 | 38 | 52 | 6 | 0 | 98 | <1 | 1.42 | 10 |
| 20-25 | 1 | 0 | 1 | 33 | 57 | 8 | 0 | 99 | <1 | 1.48 | 8 |
| 25-30 | 1 | 0 | 1 | 29 | 59 | 10 | 0 | 99 | <1 | 1.44 | 7 |
| 30-35 | 0 | 1 | 2 | 32 | 57 | 8 | 0 | 99 | <1 | 1.51 | 7 |
| 35-40 | 0 | 0 | 1 | 29 | 57 | 13 | 0 | 100 | 1 | 1.60 | 8 |
| 40-45 | 0 | 0 | 2 | 24 | 40 | 34 | 0 | 100 | 1 | 1.46 | 8 |
| 45-50 | 0 | 1 | 2 | 32 | 55 | 10 | 0 | 99 | 1 | 1.56 | 8 |
| 50-55 | 0 | 0 | 1 | 42 | 55 | 2 | 0 | 99 | <1 | 1.55 | 7 |
| 55-60 | 0 | 0 | 1 | 50 | 48 | 1 | 0 | 100 | <1 | 1.48 | 7 |
| 60-65 | 1 | 1 | 1 | 51 | 47 | 1 | 0 | 99 | <1 | 1.42 | 8 |
| 65-70 | 0 | 1 | 1 | 41 | 57 | 2 | 0 | 99 | <1 | 1.49 | 9 |
| 70-75 | 1 | 1 | 1 | 33 | 61 | 5 | 0 | 99 | <1 | 1.51 | 7 |
| 75-80 | 1 | 0 | 3 | 60 | 37 | 0 | 0 | 99 | <1 | 1.32 | 7 |
| 80-85 | 0 | 0 | 3 | 59 | 35 | 3 | 0 | 99 | <1 | 1.30 | 8 |
| 85-90 | 1 | 1 | 2 | 65 | 31 | 2 | 0 | 98 | <1 | 1.36 | 8 |
| 90-95 | 1 | 0 | 1 | 31 | 60 | 8 | 0 | 99 | <1 | 1.34 | 7 |
| 95-100 | 1 | 0 | 1 | 30 | 60 | 9 | 0 | 99 | <1 | 1.38 | 9 |
| 100-105 | 0 | 0 | 2 | 44 | 48 | 6 | 0 | 100 | <1 | 1.37 | 12 |
| 105-110 | 1 | 1 | 3 | 40 | 52 | 5 | 0 | 98 | <1 | 1.39 | 12 |
| 110-115 | 1 | 0 | 2 | 17 | 70 | 11 | 0 | 99 | <1 | 1.38 | 12 |
| 115-120 | 1 | 0 | 3 | 43 | 49 | 4 | 0 | 99 | <1 | 1.35 | 19 |
| 120-125 | 1 | 0 | 4 | 36 | 53 | 6 | 0 | 99 | <1 | 1.44 | 21 |
| 125-130 | 0 | 0 | 3 | 40 | 52 | 4 | 0 | 99 | <1 | 1.45 | 23 |
| 130-135 | 0 | 1 | 3 | 23 | 69 | 4 | 0 | 99 | <1 | 1.43 | 22 |
| 135-140 | 1 | 0 | 1 | 19 | 75 | 5 | 0 | 99 | <1 | 1.49 | 26 |
| 140-145 | 1 | 0 | 2 | 24 | 69 | 4 | 0 | 99 | <1 | 1.49 | 28 |
| 145-150 | 1 | 0 | 2 | 22 | 72 | 3 | 0 | 99 | <1 | .73 | 15 |

Appendix 4. Kjeldahl N, total P, total S, exchangeable cations, cation exchange capacity, base saturation, and soil pH by depth. Site 1

| Depth | TKN | TP | TS | Exchangeable Cations | | | | | CEC | Base sat. | pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Ca | Mg | K | Na | H | | | Water | $CaCl_2$ |
| (cm) | - - - - - - - - - - - - - | | | (mg/kg) | - - - - - - - - - - - - - - - | | | | (cmole/kg) | (%) | | |
| 0-5 | 62 | 315 | 317 | 267 | 35.5 | 55.8 | 18.5 | 10.2 | 12.1 | 15 | 3.8 | 3.5 |
| 5-10 | 921 | 449 | 95 | 25 | 4.6 | 19.2 | 16.2 | 7.8 | 8.1 | 3 | 4.0 | 3.8 |
| 10-15 | 662 | 434 | 87 | 16 | 2.6 | 14.9 | 16.5 | 8.3 | 8.5 | 3 | 4.5 | 4.3 |
| 15-20 | 611 | 420 | 83 | 13 | 1.6 | 11.6 | 15.1 | 6.2 | 6.3 | 3 | 4.7 | 4.6 |
| 20-25 | 438 | 341 | 63 | 13 | 1.3 | 10.2 | 13.4 | 4.8 | 5.0 | 3 | 4.7 | 4.4 |
| 25-30 | 315 | 285 | 59 | 14 | 1.2 | 9.5 | 14.7 | 4.1 | 4.2 | 4 | 4.7 | 4.6 |
| 30-35 | 428 | 334 | 46 | 14 | 1.2 | 8.8 | 13.6 | 3.8 | 4.0 | 4 | 4.8 | 4.7 |
| 35-40 | 225 | 235 | 39 | 19 | 1.4 | 9.4 | 15.0 | 2.8 | 3.0 | 7 | 5.0 | 4.6 |
| 40-45 | 271 | 235 | 36 | 26 | 1.8 | 8.6 | 14.6 | 2.4 | 2.7 | 11 | 5.1 | 4.7 |
| 45-50 | 249 | 182 | 39 | 25 | 1.7 | 7.4 | 17.1 | 1.9 | 2.1 | 11 | 5.1 | 4.8 |
| 50-55 | 138 | 180 | 35 | 22 | 1.5 | 5.9 | 14.7 | 1.5 | 1.7 | 11 | 5.2 | 4.8 |
| 55-60 | 156 | 159 | 26 | 21 | 1.4 | 4.6 | 14.9 | 1.1 | 1.3 | 14 | 5.2 | 4.8 |
| 60-65 | 67 | 107 | 24 | 19 | 1.3 | 3.9 | 15.6 | 0.9 | 1.1 | 17 | 5.2 | 4.9 |
| 65-70 | 60 | 95 | 28 | 19 | 1.2 | 3.8 | 15.1 | 0.7 | 0.9 | 20 | 5.3 | 4.9 |
| 70-75 | 42 | 82 | 25 | 18 | 1.2 | 3.6 | 13.8 | 0.7 | 0.9 | 20 | 5.3 | 4.9 |
| 75-80 | 40 | 98 | 23 | 20 | 1.4 | 3.7 | 14.5 | 0.7 | 0.9 | 20 | 5.3 | 4.9 |
| 80-85 | 69 | 91 | 28 | 21 | 1.6 | 4.2 | 14.3 | 0.7 | 0.9 | 21 | 5.3 | 4.9 |
| 85-90 | 36 | 95 | 30 | 26 | 2.0 | 4.5 | 16.0 | 0.6 | 0.8 | 28 | 5.2 | 4.8 |
| 90-95 | 49 | 92 | 23 | 24 | 1.8 | 4.1 | 14.6 | 0.6 | 0.8 | 27 | 5.2 | 4.8 |
| 95-100 | 44 | 99 | 31 | 25 | 1.8 | 4.6 | 13.8 | 0.6 | 0.8 | 27 | 5.2 | 4.8 |
| 100-105 | 86 | 81 | 35 | 26 | 2.3 | 4.7 | 13.9 | 0.5 | 0.8 | 29 | 5.2 | 4.7 |
| 105-110 | 33 | 88 | 22 | 20 | 1.5 | 4.0 | 12.2 | 0.5 | 0.7 | 26 | 5.2 | 4.8 |
| 110-115 | 49 | 94 | 22 | 24 | 2.1 | 4.7 | 12.5 | 0.6 | 0.8 | 26 | 5.2 | 4.8 |
| 115-120 | 31 | 86 | 41 | 21 | 1.8 | 4.0 | 14.0 | 0.6 | 0.8 | 25 | 5.2 | 4.8 |
| 120-125 | 50 | 96 | 35 | 25 | 2.0 | 4.6 | 13.3 | 0.6 | 0.8 | 27 | 5.2 | 4.7 |
| 125-130 | 45 | 87 | 27 | 22 | 1.8 | 4.2 | 14.2 | 0.6 | 0.8 | 26 | 5.3 | 4.7 |
| 130-135 | 39 | 94 | 23 | 20 | 1.5 | 3.8 | 14.2 | 0.6 | 0.7 | 24 | 5.2 | 4.7 |
| 135-140 | 46 | 95 | 23 | 22 | 1.9 | 4.2 | 15.0 | 0.6 | 0.8 | 30 | 5.2 | 4.8 |
| 140-145 | 38 | 97 | 25 | 26 | 2.1 | 4.5 | 14.8 | 0.6 | 0.8 | 28 | 5.2 | 4.7 |
| 145-150 | 83 | 87 | 2 | 27 | 2.5 | 4.6 | 14.2 | 0.6 | 0. | 29 | 5.4 | 4.9 |

Appendix 4. (Continued). Site 2

| Depth | TKN | TP | TS | Exchangeable Cations | | | | | CEC | Base sat. | pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Ca | Mg | K | Na | H | | | Water | $CaCl_2$ |
| (cm) | - - - - - - - - - - - - - - | | | mg/kg | - - - - - - - - - - - - - - - | | | | (meq) | (%) | | |
| 0-5 | 42 | 306 | 340 | 322 | 38.9 | 75.5 | 16.1 | 6.7 | 8.85 | 23.6 | 5.0 | 4.5 |
| 5-10 | 706 | 185 | 180 | 265 | 16.4 | 15.6 | 17.0 | 4.0 | 5.55 | 26.2 | 5.0 | 4.5 |
| 10-15 | 455 | 176 | 172 | 255 | 10.1 | 11.6 | 14.6 | 2.5 | 3.97 | 32.9 | 5.4 | 4.5 |
| 15-20 | 403 | 235 | 130 | 247 | 7.8 | 13.4 | 16.1 | 2.8 | 4.22 | 30.0 | 5.5 | 4.7 |
| 20-25 | 521 | 400 | 150 | 230 | 12.4 | 14.3 | 17.0 | 3.7 | 5.08 | 24.6 | 5.6 | 4.9 |
| 25-30 | 304 | 363 | 143 | 205 | 15.4 | 12.6 | 17.1 | 4.1 | 5.32 | 21.9 | 5.6 | 4.9 |
| 30-35 | 349 | 456 | 83 | 185 | 10.4 | 11.9 | 14.5 | <.5 | 4.80 | 21.0 | 5.7 | 5.0 |
| 35-40 | 524 | 541 | 113 | 129 | 8.6 | 10.9 | 16.6 | 3.3 | 4.15 | 17.6 | 5.8 | 5.2 |
| 40-45 | 204 | 233 | 107 | 79 | 6.3 | 8.2 | 16.2 | 2.7 | 3.26 | 14.6 | 5.8 | 5.1 |
| 45-50 | 502 | 203 | 43 | 52 | 4.9 | 8.2 | 15.6 | 2.1 | 2.45 | 13.5 | 5.8 | 5.1 |
| 50-55 | 238 | 221 | 32 | 50 | 5.1 | 8.0 | 16.1 | 1.4 | 1.82 | 15.8 | 5.8 | 5.1 |
| 55-60 | 277 | 186 | 43 | 46 | 5.0 | 7.0 | 17.1 | 1.4 | 1.80 | 16.1 | 5.8 | 5.0 |
| 60-65 | 122 | 156 | 28 | 44 | 5.5 | 6.4 | 12.6 | 1.1 | 1.47 | 17.1 | 5.8 | 4.9 |
| 65-70 | 129 | 147 | 36 | 35 | 4.3 | 5.7 | 15.3 | 1.0 | 1.28 | 17.3 | 5.7 | 5.0 |
| 70-75 | 101 | 155 | 47 | 30 | 3.8 | 4.6 | 14.9 | 0.8 | 1.02 | 17.8 | 5.7 | 4.7 |
| 75-80 | 65 | 125 | 19 | 26 | 2.9 | 4.9 | 15.1 | 0.6 | .85 | 17.0 | 5.6 | 4.9 |
| 80-85 | 52 | 77 | 46 | 31 | 2.9 | 5.8 | 14.2 | 0.6 | .82 | 19.7 | 5.5 | 4.8 |
| 85-90 | 160 | 134 | 72 | 59 | 6.6 | 8.7 | 14.6 | 1.2 | 1.63 | 17.1 | 5.5 | 4.7 |
| 90-95 | 265 | 152 | 38 | 128 | 27.8 | 17.8 | 15.7 | 2.0 | 2.96 | 28.8 | 5.1 | 4.4 |
| 95-100 | 197 | 166 | 29 | 127 | 28.6 | 18.6 | 17.6 | 2.6 | 3.55 | 24.8 | 5.2 | 4.4 |
| 100-105 | 258 | 128 | 9 | 53 | 5.3 | 7.2 | 15.2 | 1.4 | 1.79 | 17.5 | 5.5 | 4.6 |
| 105-110 | 216 | 159 | 1 | 49 | 4.9 | 7.0 | 17.0 | 1.1 | 1.50 | 19.6 | 5.5 | 4.6 |
| 110-115 | 194 | 129 | 1 | 82 | 4.3 | 6.2 | 17.0 | 1.3 | 1.93 | 22.5 | 5.3 | 4.5 |
| 115-120 | 194 | 149 | 2 | 34 | 4.1 | 5.4 | 16.7 | 1.4 | 2.04 | 26.3 | 5.4 | 4.6 |
| 120-125 | 172 | 144 | 6 | 68 | 11.3 | 9.8 | 17.2 | 1.5 | 2.01 | 23.6 | 5.4 | 4.5 |
| 135-130 | 305 | 163 | 9 | 98 | 23.1 | 14.2 | 17.4 | 3.4 | 4.15 | 18.0 | 5.1 | 4.3 |
| 130-135 | 155 | 152 | 5 | 148 | 33.7 | 20.6 | 17.7 | 3.1 | 4.21 | 25.8 | 4.9 | 4.1 |
| 135-140 | 175 | 161 | 2 | 100 | 25.7 | 15.4 | 19.6 | 3.1 | 3.93 | 19.9 | 5.0 | 4.3 |
| 140-145 | 185 | 161 | 2 | 78 | 22.7 | 12.6 | 18.4 | 2.9 | 3.61 | 17.9 | 4.8 | 4.1 |
| 145-150 | 178 | 137 | 2 | 96 | 26.2 | 15.4 | 17.1 | 3.0 | 3.77 | 20.2 | 4.9 | 4.3 |

Appendix 4. (Continued). Site 3

| Depth | TKN | TP | TS | Exchangeable Cations | | | | | CEC | Base sat. | pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Ca | Mg | K | Na | H | | | Water | $CaCl_2$ |
| (cm) | - - - - - - - | - - - - | - - - - | - - mg/kg - - | - - - - | - - - - | - - - - | - - - - | (meq) | (%) | | |
| 0-5 | 58 | 422 | 212 | 921 | 41.2 | 84.5 | 21.8 | 1.2 | 17.65 | 32.0 | 4.9 | 4.5 |
| 5-10 | 43 | 443 | 136 | 423 | 31.4 | 31.5 | 19.2 | 11.8 | 14.44 | 18.1 | 4.5 | 4.1 |
| 10-15 | 1090 | 279 | 71 | 202 | 29.6 | 17.8 | 21.1 | 9.3 | 10.65 | 13.0 | 4.7 | 4.3 |
| 15-20 | 784 | 608 | 67 | 179 | 25.7 | 11.0 | 21.0 | 8.9 | 10.16 | 12.0 | 5.1 | 4.6 |
| 20-25 | 1040 | 941 | 47 | 171 | 22.4 | 19.0 | 20.2 | 6.7 | 7.88 | 15.0 | 5.2 | 4.7 |
| 25-30 | 506 | 517 | 34 | 168 | 16.6 | 21.8 | 17.9 | 4.7 | 5.81 | 18.9 | 5.7 | 5.0 |
| 30-35 | 450 | 404 | 27 | 171 | 14.6 | 18.7 | 15.0 | 3.8 | 4.84 | 22.5 | 5.7 | 5.1 |
| 35-40 | 343 | 330 | 21 | 137 | 10.6 | 14.8 | 18.0 | 3.1 | 4.01 | 22.2 | 5.8 | 5.1 |
| 40-45 | 254 | 398 | 31 | 114 | 8.3 | 13.3 | 16.8 | 2.5 | 3.28 | 22.6 | 5.8 | 5.2 |
| 45-50 | 238 | 301 | 9 | 87 | 5.0 | 10.3 | 14.2 | 1.9 | 2.44 | 23.0 | 5.8 | 5.2 |
| 50-55 | 134 | 297 | 12 | 73 | 4.0 | 9.3 | 14.8 | 1.6 | 2.09 | 23.0 | 5.8 | 5.2 |
| 55-60 | 108 | 281 | 11 | 64 | 3.8 | 10.4 | 15.2 | 1.3 | 1.74 | 25.3 | 5.8 | 5.1 |
| 60-65 | 76 | 266 | 21 | 60 | 3.7 | 10.6 | 13.6 | 1.2 | 1.61 | 26.1 | 5.8 | 5.1 |
| 65-70 | 72 | 220 | 9 | 66 | 4.2 | 11.4 | 12.8 | 1.0 | 1.47 | 30.6 | 5.8 | 5.1 |
| 70-75 | 64 | 220 | 5 | 63 | 4.2 | 12.4 | 15.2 | 1.0 | 1.46 | 30.8 | 5.8 | 5.1 |
| 75-80 | 83 | 213 | 2 | 58 | 4.2 | 11.0 | 14.3 | .8 | 1.25 | 32.8 | 5.8 | 5.1 |
| 80-85 | 80 | 219 | 13 | 57 | 6.2 | 10.8 | 13.4 | .6 | 1.00 | 42.0 | 5.8 | 5.0 |
| 85-90 | 62 | 325 | 4 | 68 | 14.4 | 9.6 | 13.4 | .6 | 1.10 | 49.0 | 5.7 | 4.9 |
| 90-95 | 73 | 214 | 15 | 68 | 16.3 | 8.9 | 14.9 | .5 | 1.09 | 51.4 | 5.7 | 4.9 |
| 95-100 | 79 | 229 | 10 | 61 | 14.2 | 8.4 | 13.9 | .5 | 1.04 | 48.0 | 5.6 | 4.8 |
| 100-105 | 49 | 193 | -- | 54 | 9.0 | 7.4 | 14.1 | .7 | 1.14 | 36.8 | 5.7 | 4.9 |
| 105-110 | 57 | 237 | -- | 55 | 9.8 | 7.3 | 15.0 | .9 | 1.32 | 33.3 | 5.6 | 4.9 |
| 110-115 | 45 | 253 | -- | 62 | 12.4 | 7.9 | 14.6 | .6 | 1.09 | 45.0 | 5.7 | 4.9 |
| 115-120 | 51 | 229 | -- | 55 | 10.6 | 7.5 | 14.4 | .6 | 1.04 | 42.3 | 5.7 | 4.9 |
| 120-125 | 62 | 181 | -- | 56 | 8.4 | 6.7 | 14.7 | .7 | 1.09 | 39.4 | 5.6 | 4.9 |
| 125-130 | 79 | 258 | -- | 58 | 9.4 | 7.0 | 15.7 | .6 | 1.06 | 42.4 | 5.6 | 4.9 |
| 130-135 | 73 | 220 | -- | 53 | 9.8 | 7.4 | 14.2 | .5 | .90 | 46.7 | 5.6 | 4.9 |
| 135-140 | 46 | 217 | -- | 60 | 11.8 | 8.3 | 15.4 | .5 | .93 | 51.6 | 5.6 | 4.9 |
| 140-145 | 66 | 245 | -- | 41 | 5.7 | 7.5 | 14.9 | .4 | .78 | 43.6 | 5.6 | 4.9 |

Appendix 4. (Continued). Site 4

| Depth | TKN | TP | TS | Exchangeable Cations | | | | | CEC | Base sat. | pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Ca | Mg | K | Na | H | | | Water | $CaCl_2$ |
| (cm) | - - - - - - - | - - - - | - - - - | - - mg/kg - - | - - - - | - - - - | - - - - | - - - - | (meq) | (%) | | |
| 0-5 | 1540 | 235 | 127 | 76 | 21.2 | 30.0 | 15.6 | 10.2 | 10.88 | 6.2 | 4.1 | 3.8 |
| 5-10 | 998 | 164 | 119 | 26 | 10.6 | 12.3 | 16.6 | 8.5 | 8.86 | 3.5 | 4.0 | 3.7 |
| 10-15 | 767 | 234 | 43 | 32 | 16.3 | 13.8 | 14.9 | 5.5 | 5.89 | 6.2 | 4.3 | 4.0 |
| 15-20 | 714 | 489 | 65 | 26 | 1.1 | 10.6 | 15.5 | 6.4 | 6.67 | 4.4 | 4.5 | 4.2 |
| 20-25 | 639 | 477 | 79 | 19 | 6.5 | 9.7 | 15.4 | 6.7 | 6.94 | 3.3 | 4.7 | 4.5 |
| 25-30 | 584 | 362 | 58 | 17 | 3.8 | 9.0 | 15.8 | 5.2 | 5.43 | 3.6 | 4.8 | 4.6 |
| 30-35 | 266 | 251 | 47 | 14 | 2.7 | 6.4 | 13.0 | 3.4 | 3.60 | 4.0 | 4.9 | 4.7 |
| 35-40 | 255 | 254 | 55 | 15 | 2.8 | 4.6 | 13.8 | 2.6 | 2.79 | 5.5 | 5.1 | 4.8 |
| 40-45 | 162 | 240 | 44 | 15 | 2.6 | 3.8 | 13.9 | 2.1 | 2.30 | 6.2 | 5.1 | 4.6 |
| 45-50 | 120 | 214 | 37 | 15 | 2.4 | 3.4 | 14.7 | 1.3 | 1.49 | 9.7 | 5.2 | 4.8 |
| 50-55 | 160 | 233 | 74 | 16 | 2.2 | 3.0 | 14.2 | 1.4 | 1.53 | 9.9 | 5.3 | 4.9 |
| 55-60 | 208 | 224 | 27 | 16 | 1.8 | 2.2 | 11.4 | 1.3 | 1.45 | 9.4 | 5.3 | 4.9 |
| 60-65 | 120 | 200 | 27 | 15 | 1.8 | 2.6 | 12.7 | 1.2 | 1.37 | 10.9 | 5.4 | 4.9 |
| 65-70 | 186 | 165 | 23 | 14 | 1.4 | 2.3 | 14.0 | .9 | 1.09 | 12.6 | 5.4 | 4.9 |
| 70-75 | 71 | 164 | 29 | 13 | 1.2 | 2.3 | 14.4 | .8 | .96 | 15.6 | 5.4 | 4.9 |
| 75-80 | 75 | 161 | 26 | 15 | 1.4 | 2.2 | 13.8 | .9 | 1.07 | 12.2 | 5.4 | 4.8 |
| 80-85 | 63 | 197 | 28 | 13 | .1 | 2.1 | 14.2 | .6 | .74 | 18.9 | 5.4 | 4.9 |
| 85-90 | 64 | 180 | 24 | 11 | .9 | 2.1 | 12.7 | .6 | .74 | 16.2 | 5.3 | 4.9 |
| 90-95 | 57 | 146 | 41 | 12 | .8 | 2.9 | 15.3 | .6 | .72 | 19.4 | 5.4 | 5.4 |
| 95-100 | 50 | 131 | 24 | 11 | .9 | 2.4 | 14.6 | .4 | .50 | 26.0 | 5.4 | 5.4 |
| 100-105 | 50 | 144 | 24 | 10 | .7 | 2.6 | 12.3 | .4 | .54 | 20.4 | 5.4 | 5.4 |
| 105-110 | 50 | 169 | 15 | 12 | .8 | 2.6 | 18.0 | .4 | .55 | 27.3 | 5.4 | 5.4 |
| 110-115 | 43 | 140 | 12 | 11 | .7 | 2.5 | 13.4 | .4 | .53 | 28.9 | 5.5 | 5.5 |
| 115-120 | 47 | 162 | 10 | 11 | .8 | 2.6 | 15.8 | .4 | .51 | 27.5 | 5.5 | 5.5 |
| 120-125 | 40 | 154 | 12 | 12 | .9 | 2.3 | 13.5 | .4 | .51 | 25.5 | 5.4 | 5.4 |
| 125-130 | 43 | 144 | 11 | 15 | 1.2 | 2.9 | 13.9 | .4 | .51 | 29.4 | 5.5 | 5.5 |

Appendix 4. (Continued). Site 5

| Depth | TKN | TP | TS | Exchangeable Cations | | | | | CEC | Base sat. | pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Ca | Mg | K | Na | H | | | Water | $CaCl_2$ |
| (cm) | - - - - - | - - - - - | - - - - - | mg/kg | - - - - - | - - - - - | - - - - - | - - - - - | (meq) | (%) | | |
| 0-5 | 1010 | 179 | 114 | 105 | 18.6 | 40.8 | 17.6 | 6.1 | 6.94 | 11.6 | 4.4 | 3.9 |
| 5-10 | 997 | 18 | 78 | 72 | 7.0 | 14.8 | 13.1 | 5.0 | 5.51 | 8.6 | 4.3 | 3.9 |
| 10-15 | 1070 | 133 | 66 | 71 | 7.7 | 12.0 | 15.7 | 4.9 | 5.46 | 8.9 | 4.3 | 3.8 |
| 15-20 | 509 | 159 | 69 | 54 | 6.7 | 11.2 | 15.4 | 5.5 | 5.88 | 6.2 | 4.6 | 4.0 |
| 20-25 | 473 | 286 | 59 | 22 | 2.8 | 8.4 | 14.5 | 5.4 | 5.64 | 3.7 | 4.8 | 4.5 |
| 25-30 | 362 | 214 | 43 | 17 | 1.7 | 6.8 | 14.4 | .0 | 4.44 | 3.8 | 5.0 | 4.6 |
| 30-35 | 250 | 106 | 32 | 13 | 1.1 | 4.9 | 13.9 | 2.2 | 2.38 | 5.4 | 5.1 | 4.8 |
| 35-40 | 216 | 101 | 29 | 10 | .7 | 3.4 | 12.0 | 1.7 | 1.86 | 6.0 | 5.1 | 4.9 |
| 40-45 | 307 | 89 | 37 | 12 | .7 | 3.0 | 15.7 | 1.4 | 1.50 | 8.8 | 5.2 | 4.9 |
| 45-50 | 195 | 75 | 34 | 11 | .7 | 2.5 | 3.7 | 1.2 | 1.31 | 9.6 | 5.2 | 4.9 |
| 50-55 | 189 | 84 | 32 | 12 | .7 | 2.6 | 15.0 | .8 | .96 | 13.9 | 5.2 | 4.9 |
| 55-60 | 170 | 70 | 32 | 10 | .6 | 2.8 | 12.0 | .6 | .70 | 15.7 | 5.3 | 4.9 |
| 60-65 | 98 | 65 | 37 | 10 | .6 | 3.1 | 13.9 | .4 | .54 | 22.2 | 5.3 | 4.8 |
| 65-70 | 64 | 69 | 28 | 9 | .5 | 3.5 | 13.0 | .2 | .45 | 31.4 | 5.3 | 4.8 |
| 70-75 | 96 | 96 | 19 | 8 | .5 | 3.0 | 12.1 | .3 | .43 | 25.6 | 5.3 | 4.8 |
| 75-80 | 92 | 92 | 18 | 9 | .5 | 2.5 | 12.2 | .3 | .41 | 26.8 | 5.3 | 4.8 |
| 80-85 | 99 | 86 | 29 | 9 | .5 | 2.2 | 12.9 | .3 | .39 | 28.2 | 5.2 | 4.8 |
| 85-90 | 89 | 79 | 31 | 9 | .5 | 3.1 | 13.8 | .3 | .43 | 34.4 | 5.3 | 4.9 |
| 90-95 | 69 | 87 | 31 | 10 | .5 | 2.9 | 14.2 | .3 | .44 | 35.3 | 5.3 | 4.8 |
| 95-100 | 65 | 74 | 52 | 11 | .6 | 3.2 | 14.1 | .4 | .51 | 34.2 | 5.3 | 4.8 |
| 100-105 | 66 | 79 | 38 | 11 | .5 | 2.7 | 13.8 | .4 | .56 | 29.3 | 5.3 | 4.8 |
| 105-110 | 53 | 62 | 43 | 11 | .5 | 2.4 | 13.5 | .4 | .54 | 28.6 | 5.3 | 4.9 |
| 110-115 | 46 | 61 | 50 | 12 | .6 | 3.1 | 13.6 | .4 | .55 | 23.6 | 5.4 | 4.8 |
| 115-120 | 41 | 73 | 31 | 12 | .6 | 3.3 | 13.9 | .5 | .67 | 19.4 | 5.4 | 4.8 |
| 120-125 | 45 | 95 | 49 | 12 | .6 | 4.4 | 15.0 | .7 | .82 | 17.1 | 5.4 | 4.9 |
| 125-130 | 44 | 97 | 25 | 12 | .6 | 3.5 | 14.6 | .5 | .62 | 22.6 | 5.4 | 4.8 |
| 130-135 | 59 | 78 | 41 | 13 | .6 | 3.4 | 14.7 | .3 | .42 | 23.3 | 5.4 | 4.9 |

Appendix 4. (Continued). Site 6

| Depth | TKN | TP | TS | Exchangeable Cations - - - - - | | | | | CEC | Base sat. | pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Ca | Mg | K | Na | H | | | Water | $CaCl_2$ |
| (cm) | - - - - - | - - - - - | - - - - - | mg/kg | - - - - - | - - - - - | - - - - - | - - - - - | (meq) | (%) | | |
| 0-5 | 41 | 253 | 146 | 162 | 23.7 | 39.5 | 15.0 | 8.0 | 9.17 | 12.8 | 4.6 | 4.1 |
| 5-10 | 646 | 215 | 54 | 89 | 10.2 | 12.1 | 15.8 | 5.4 | 6.05 | 10.4 | 4.8 | 4.3 |
| 10-15 | 570 | 194 | 48 | 103 | 12.0 | 9.8 | 12.3 | 5.2 | 5.87 | 11.8 | 4.9 | 4.3 |
| 15-20 | 795 | 300 | 61 | 62 | 7.2 | 8.2 | 16.4 | 6.3 | 6.74 | 6.8 | 5.0 | 4.4 |
| 20-25 | 537 | 264 | 45 | 46 | 6.1 | 8.0 | 14.4 | 5.3 | 5.70 | 6.3 | 4.9 | 4.5 |
| 25-30 | 329 | 264 | 40 | 23 | 2.7 | 7.8 | 16.1 | 4.2 | 4.45 | 5.2 | 5.0 | 4.4 |
| 30-35 | 235 | 231 | 30 | 22 | 2.6 | 6.5 | 15.3 | 3.6 | 3.82 | 5.8 | 5.1 | 4.6 |
| 35-40 | 266 | 201 | 29 | 22 | 3.5 | 5.4 | 16.1 | 3.0 | 3.22 | 6.8 | 5.1 | 4.6 |
| 40-45 | 195 | 261 | 25 | 18 | 2.2 | 4.8 | 15.1 | 2.7 | 2.91 | 6.5 | 5.1 | 4.7 |
| 45-50 | 196 | 349 | 26 | 15 | 1.4 | 4.0 | 15.5 | 2.6 | 2.75 | 6.2 | 5.1 | 4.7 |
| 50-55 | 131 | 298 | 25 | 14 | 1.2 | 3.2 | 15.6 | 2.6 | 2.72 | 5.8 | 5.1 | 4.8 |
| 55-60 | 96 | 281 | 19 | 12 | .9 | 2.6 | 12.1 | 1.9 | 2.01 | 6.5 | 5.1 | 4.8 |
| 60-65 | 61 | 230 | 17 | 14 | .9 | 2.4 | 16.2 | 1.5 | 1.61 | 9.3 | 5.2 | 4.8 |
| 65-70 | 65 | 213 | 15 | 12 | .7 | 2.6 | 15.8 | 1.3 | 1.42 | 9.9 | 5.2 | 4.9 |
| 70-75 | 77 | 217 | 13 | 12 | .6 | 2.1 | 14.6 | 1.1 | 1.21 | 10.7 | 5.1 | 4.8 |
| 75-80 | 58 | 171 | 12 | 11 | .6 | 2.1 | 14.9 | .9 | .99 | 13.1 | 5.2 | 4.7 |
| 80-85 | 45 | 153 | 13 | 12 | .7 | 2.1 | 14.4 | <.1 | .76 | 18.4 | 5.2 | 4.8 |
| 85-90 | 76 | 130 | 15 | 17 | .7 | 2.8 | 15.6 | .7 | .90 | 20.0 | 5.2 | 4.7 |
| 90-95 | 51 | 110 | 11 | 11 | .6 | 2.3 | 14.6 | .3 | .41 | 31.7 | 5.3 | 4.8 |
| 95-100 | 58 | 95 | 9 | 12 | .6 | 1.9 | 15.9 | .3 | .43 | 34.9 | 5.3 | 4.9 |
| 100-105 | 73 | 90 | 8 | 10 | .6 | 2.6 | 14.1 | <.1 | .34 | 35.3 | 5.3 | 4.8 |
| 105-110 | 72 | 84 | 13 | 9 | .5 | 2.4 | 11.4 | .2 | .30 | 33.3 | 5.3 | 4.8 |
| 110-115 | 59 | 88 | 11 | 10 | .6 | 2.3 | 12.2 | .3 | .37 | 29.7 | 5.3 | 4.7 |
| 115-120 | 65 | 81 | 10 | 12 | .6 | 3.3 | 14.8 | .3 | .44 | 31.8 | 5.3 | 4.7 |
| 120-125 | 6 | 81 | 9 | 11 | .6 | 2.6 | 13.3 | .4 | .31 | 25.5 | 5.3 | 4.8 |

Appendix 4. (Continued). Site 7

| Depth | TKN | TP | TS | Exchangeable Cations | | | | | CEC | Base sat. | pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Ca | Mg | K | Na | H | | | Water | $CaCl_2$ |
| (cm) | - - - - - - - - - - | - - - - - | - - - - - | mg/kg | - - - - - | - - - - - | - - - - - | - - - - - | (meq) | (%) | | |
| 0-5 | 122 | 656 | 261 | 1910 | 49.1 | 105.6 | 18.2 | 20.4 | 32.41 | 37.1 | 4.6 | 4.4 |
| 5-10 | 335 | 399 | 78 | 472 | 36.8 | 33.8 | 16.0 | 11.3 | 14.24 | 20.4 | 4.2 | 3.9 |
| 10-15 | 1420 | 1050 | 92 | 233 | 29.5 | 30.4 | 17.3 | 15.2 | 17.13 | 11.5 | 4.3 | 4.1 |
| 15-20 | 1070 | 1050 | 80 | 180 | 20.6 | 20.6 | 17.0 | 15.5 | 16.68 | 7.2 | 4.7 | 4.4 |
| 20-25 | 883 | 1020 | 74 | 162 | 14.7 | 15.1 | 15.5 | 11.7 | 12.74 | 8.2 | 5.0 | 4.5 |
| 25-30 | 718 | 619 | 64 | 122 | 9.8 | 13.4 | 17.2 | 8.5 | 9.28 | 8.6 | 5.1 | 4.6 |
| 30-35 | 458 | 633 | 38 | 90 | 6.9 | 10.1 | 15.2 | 6.7 | 7.28 | 8.2 | 5.1 | 4.6 |
| 35-40 | 431 | 585 | 32 | 81 | 6.2 | 8.6 | 16.2 | 5.2 | 5.67 | 8.8 | 5.2 | 4.7 |
| 40-45 | 227 | 406 | 23 | 57 | 4.3 | 6.6 | 13.5 | 4.0 | 4.38 | 9.1 | 5.2 | 4.7 |
| 45-50 | 314 | 359 | 19 | 41 | 3.0 | 6.6 | 15.0 | 3.0 | 3.27 | 9.5 | 5.2 | 4.7 |
| 50-55 | 300 | 325 | 17 | 34 | 2.9 | 5.6 | 13.8 | 2.7 | 2.97 | 9.1 | 5.3 | 4.8 |
| 55-60 | 137 | 331 | 17 | 31 | 2.6 | 5.4 | 15.7 | 2.3 | 2.54 | 10.2 | 5.3 | 4.7 |
| 60-65 | 122 | 222 | 18 | 30 | 2.9 | 6.0 | 13.2 | 2.0 | 2.25 | 11.1 | 5.4 | 4.7 |
| 65-70 | 211 | 297 | 18 | 31 | 3.1 | 8.6 | 12.8 | 2.9 | 3.17 | 7.9 | 5.3 | 4.8 |
| 70-75 | 142 | 256 | 17 | 28 | 2.7 | 8.6 | 14.6 | 2.4 | 2.68 | 9.0 | 5.4 | 4.8 |
| 75-80 | 156 | 286 | 16 | 27 | 2.2 | 7.4 | 15.4 | 1.8 | 2.02 | 11.9 | 5.3 | 4.7 |
| 80-85 | 172 | 282 | 14 | 33 | 2.6 | 7.1 | 15.7 | 2.3 | 2.55 | 10.6 | 5.3 | 4.7 |
| 85-90 | 133 | 279 | 17 | 29 | 2.0 | 5.4 | 16.5 | 2.2 | 2.50 | 10.4 | 5.3 | 4.6 |
| 90-95 | 344 | 285 | 14 | 30 | 2.2 | 5.6 | 15.8 | 2.2 | 2.41 | 10.4 | 5.3 | 4.7 |
| 95-100 | 236 | 253 | 25 | 40 | 4.6 | 6.1 | 14.5 | 4.1 | 4.40 | 7.3 | 4.6 | 4.3 |
| 100-105 | 138 | 255 | 23 | 44 | 5.8 | 6.1 | 14.0 | 3.5 | 3.82 | 8.9 | 4.8 | 4.2 |
| 105-110 | 131 | 224 | 18 | 26 | 2.0 | 5.8 | 14.6 | 2.5 | 2.70 | 8.1 | 4.9 | 4.5 |
| 110-115 | 143 | 308 | 22 | 39 | 3.8 | 6.6 | 13.8 | 2.6 | 2.89 | 11.4 | 4.9 | 4.4 |
| 115-120 | 76 | 298 | 17 | 29 | 2.0 | 6.5 | 14.6 | 2.4 | 2.64 | 9.1 | 5.0 | 4.5 |
| 120-125 | 68 | 286 | 16 | 27 | 1.8 | 5.4 | 15.4 | 1.5 | 1.77 | 13.0 | 5.1 | 4.6 |
| 125-130 | 64 | 296 | 15 | 23 | 1.5 | 5.5 | 13.8 | 1.9 | 2.10 | 9.5 | 5.1 | 4.6 |
| 130-135 | 80 | 288 | 18 | 27 | 2.2 | 5.1 | 13.9 | 2.2 | 2.46 | 8.9 | 5.1 | 4.6 |
| 135-140 | 69 | 310 | 18 | 31 | 2.2 | 6.5 | 14.7 | 2.5 | 2.72 | 9.6 | 5.2 | 4.6 |
| 140-145 | 56 | 293 | 18 | 32 | 2.5 | 6.5 | 16.5 | 2.4 | 2.67 | 10.1 | 5.1 | 4.6 |
| 145-150 | 71 | 282 | 17 | 44 | 3.0 | 6.8 | 15.6 | 2.1 | 2.43 | 13.6 | 5.4 | 4.8 |

Appendix 4. (Continued). Site 8

| Depth | TKN | TP | TS | Exchangeable Cations | | | | | CEC | Base sat. | pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Ca | Mg | K | Na | H | | | Water | $CaCl_2$ |
| (cm) | - - - - - - - - - - | - - - - - | - - - - - | mg/kg | - - - - - | - - - - - | - - - - - | - - - - - | (meq) | (%) | | |
| 0-5 | 48 | 324 | 103 | 176 | 29.2 | 34.1 | 16.2 | 9.9 | 11.17 | 11.4 | 4.4 | 3.9 |
| 5-10 | 787 | 280 | 58 | 85 | 12.6 | 1.2 | 13.9 | 5.7 | 6.32 | 9.8 | 4.2 | 3.8 |
| 10-15 | 909 | 379 | 75 | 104 | 9.0 | 16.9 | 15.4 | 10.6 | 11.28 | 6.2 | 4.5 | 4.2 |
| 15-20 | 515 | 358 | 77 | 46 | 3.0 | 7.3 | 15.4 | 7.7 | 8.06 | 4.2 | 4.7 | 4.2 |
| 20-25 | 346 | 296 | 38 | 27 | 1.8 | 5.3 | 14.4 | 5.4 | 5.62 | 3.9 | 4.8 | 4.5 |
| 25-30 | 310 | 266 | 35 | 24 | 1.4 | 3.7 | 15.5 | 4.9 | 5.11 | 3.7 | 4.9 | 4.5 |
| 30-35 | 238 | 209 | 39 | 25 | 1.3 | 3.6 | 13.6 | 4.3 | 4.48 | 4.5 | 5.0 | 4.5 |
| 35-40 | 219 | 187 | 27 | 20 | 1.0 | 3.4 | 15.0 | 3.4 | 3.55 | 5.4 | 4.9 | 4.6 |
| 40-45 | 535 | 130 | 28 | 16 | 1.0 | 3.9 | 14.0 | 3.4 | 3.54 | 4.5 | 4.8 | 4.4 |
| 45-50 | 290 | 180 | 19 | 15 | .9 | 4.2 | 14.5 | 3.3 | 3.50 | 4.6 | 4.9 | 4.4 |
| 50-55 | 247 | 140 | 22 | 12 | .7 | 3.9 | 12.6 | 2.4 | 2.53 | 5.1 | 5.0 | 4.5 |
| 55-60 | 191 | 156 | 21 | 13 | .8 | 4.4 | 12.6 | 1.9 | 2.00 | 7.0 | 4.9 | 4.5 |
| 60-65 | 180 | 151 | 20 | 13 | .7 | 4.2 | 1.3 | 1.8 | 1.92 | 7.3 | 5.0 | 4.6 |
| 65-70 | 97 | 163 | 14 | 13 | .6 | 4.2 | 13.4 | 2.0 | 2.12 | 5.7 | 5.0 | 4.6 |
| 70-75 | 37 | 154 | 14 | 11 | .6 | 4.1 | 11.6 | 2.1 | 2.18 | 5.5 | 5.1 | 4.7 |
| 75-80 | 49 | 150 | 17 | 14 | .7 | 4.1 | 12.6 | 2.1 | 2.20 | 6.4 | 5.1 | 4.7 |
| 80-85 | 59 | 154 | 15 | 15 | .8 | 4.2 | 12.9 | 1.8 | 1.93 | 7.8 | 5.1 | 4.7 |
| 85-90 | 139 | 111 | 12 | 16 | .8 | 4.0 | 12.4 | 1.8 | 1.93 | 7.8 | 5.2 | 4.7 |
| 90-95 | 216 | 152 | 11 | 17 | .7 | 3.9 | 13.0 | 1.3 | 1.48 | 10.8 | 5.4 | 4.8 |
| 95-100 | 395 | 146 | 13 | 17 | .6 | 4.1 | 11.5 | 1.1 | 1.23 | 12.2 | 5.4 | 4.8 |
| 100-105 | 192 | 132 | 14 | 17 | .6 | 4.0 | 14.0 | 1.1 | 1.30 | 12.3 | 5.5 | 4.8 |
| 105-110 | 127 | 189 | 11 | 17 | .6 | 3.9 | 13.0 | 1.1 | 1.30 | 12.3 | 5.5 | 4.8 |
| 110-115 | 203 | 190 | 10 | 17 | .6 | 3.8 | 12.6 | 1.0 | 1.15 | 14.5 | 5.5 | 4.8 |
| 115-120 | 128 | 159 | 14 | 18 | .7 | 3.7 | 14.2 | 1.2 | 1.34 | 11.9 | 5.3 | 4.7 |
| 120-125 | 103 | 143 | 11 | 12 | .6 | 3.4 | 10.7 | 1.3 | 1.40 | 10.0 | 5.2 | 4.8 |
| 125-130 | 119 | 193 | 11 | 16 | .7 | 3.7 | 12.7 | 1.1 | 1.29 | 11.6 | 5.3 | 4.7 |
| 130-135 | 96 | 112 | 14 | 17 | .8 | 3.8 | 13.4 | 1.2 | 1.32 | 12.1 | 5.2 | 4.7 |
| 135-140 | 123 | 87 | 14 | 15 | .8 | 3.6 | 13.2 | 1.3 | 1.45 | 10.3 | 5.2 | 4.7 |
| 140-145 | 153 | 73 | 14 | 15 | .9 | 4.6 | 11.5 | 1.2 | 1.36 | 10.3 | 5.2 | 4.8 |

Appendix 4. (Continued). Site 9

| Depth | TKN | TP | TS | Exchangeable Cations | | | | | CEC | Base sat. | pH | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Ca | Mg | K | Na | H | | | Water | CaCl$_2$ |
| (cm) | - - - - - - - - | - - - - - - | - - - - - | - - mg/kg | - - - - - - | - - - - - - | - - - - - | - - - | (meq) | (%) | | |
| 0-5 | 40 | 97 | 141 | 58 | 6.8 | 16.8 | 15.4 | 10.4 | 10.80 | 4.9 | 3.8 | 3.4 |
| 5-10 | 619 | 160 | 59 | 8 | 2.6 | 10.3 | 14.8 | 8.0 | 8.15 | 2.2 | 4.3 | 4.1 |
| 10-15 | 427 | 182 | 64 | 8 | 1.7 | 6.1 | 16.2 | 6.2 | 6.30 | 2.9 | 4.6 | 4.5 |
| 15-20 | 384 | 207 | 46 | 9 | 1.2 | 4.7 | 15.8 | 4.3 | 4.40 | 4.1 | 4.8 | 4.5 |
| 20-25 | 257 | 192 | 34 | 10 | 1.0 | 4.5 | 15.3 | 2.9 | 3.03 | 6.5 | 4.8 | 4.6 |
| 25-30 | 187 | 179 | 20 | 10 | .7 | 3.1 | 14.7 | 1.2 | 1.29 | 10.1 | 4.9 | 4.6 |
| 30-35 | 334 | 126 | 30 | 8 | .6 | 2.4 | 12.4 | 1.1 | 1.25 | 10.4 | 5.0 | 4.7 |
| 35-40 | 331 | 118 | 26 | 10 | .6 | 2.4 | 15.0 | 1.1 | 1.23 | 10.6 | 5.1 | 4.8 |
| 40-45 | 221 | 101 | 20 | 10 | .5 | 2.7 | 15.4 | 1.1 | 1.19 | 10.9 | 5.0 | 4.8 |
| 45-50 | 96 | 91 | 15 | 9 | .4 | 2.5 | 14.2 | 1.2 | 1.30 | 10.0 | 5.0 | 4.7 |
| 50-55 | 76 | 73 | 69 | 10 | .4 | 2.5 | 15.5 | 1.1 | 1.25 | 10.5 | 5.0 | 4.5 |
| 55-60 | 38 | 72 | 12 | 9 | .3 | 2.2 | 13.7 | .4 | .55 | 20.0 | 5.1 | 4.7 |
| 60-65 | 74 | 71 | 9 | 9 | .3 | 2.2 | 14.6 | .4 | .56 | 21.0 | 5.1 | 4.7 |
| 65-70 | 67 | 80 | 10 | 8 | .3 | 2.2 | 14.5 | .5 | .57 | 19.3 | 5.1 | 4.6 |
| 70-75 | 127 | 97 | 11 | 9 | .3 | 2.0 | 15.8 | .7 | .80 | 15.0 | 5.1 | 4.7 |
| 75-80 | 213 | 93 | 9 | 10 | .5 | 2.6 | 15.8 | .5 | .61 | 21.3 | 5.1 | 4.7 |
| 80-85 | 181 | 72 | 12 | 13 | .6 | 2.9 | 17.0 | .9 | 1.07 | 14.0 | 5.0 | 4.6 |
| 85-90 | 166 | 70 | 9 | 12 | .7 | 3.0 | 15.5 | .8 | .92 | 15.2 | 5.0 | 4.6 |
| 90-95 | 204 | 83 | 16 | 13 | .9 | 3.8 | 17.0 | .7 | .82 | 19.5 | 5.0 | 4.7 |
| 95-100 | 306 | 82 | 10 | 14 | .8 | 2.7 | 16.2 | .6 | .79 | 19.0 | 5.0 | 4.7 |
| 100-105 | 231 | 79 | 6 | 11 | .7 | 3.0 | 17.0 | .6 | .72 | 19.4 | 5.1 | 4.7 |
| 105-110 | 44 | 73 | 5 | 11 | .7 | 3.4 | 17.1 | .6 | .70 | 20.0 | 5.1 | 4.7 |
| 110-115 | 76 | 80 | 6 | 11 | .6 | 3.0 | 15.6 | .5 | .62 | 22.6 | 5.1 | 4.7 |
| 115-120 | 32 | 59 | 5 | 12 | .6 | 2.9 | 15.6 | .6 | .75 | 14.7 | 5.1 | 4.7 |
| 120-125 | 53 | 59 | 6 | 13 | 1.2 | 3.1 | 14.2 | .9 | 1.08 | 13.0 | 5.1 | 4.6 |
| 125-130 | 44 | 69 | 4 | 14 | 1.1 | 3.1 | 15.5 | .9 | 1.04 | 15.4 | 5.1 | 4.7 |
| 130-135 | 29 | 81 | 6 | 13 | 1.0 | 3.1 | 17.0 | .7 | .86 | 18.6 | 5.0 | 4.6 |
| 135-140 | 83 | 81 | 2 | 11 | .9 | 2.6 | 12.8 | .7 | .83 | 15.7 | 5.0 | 4.7 |
| 140-145 | 59 | 71 | 2 | 12 | .9 | 3.0 | 15.6 | .6 | .78 | 17.9 | 5.0 | 4.6 |
| 145-150 | 637 | 78 | 2 | 11 | .9 | 3.5 | 15.4 | .5 | .60 | 20.3 | .9.1 | 4.7 |

Appendix 5. Total element concentrations by depth. Site 1

| Depth | Ca | Mg | K | Na | Al | B | Cd | Cr | Cu | Fe | Mn | Ni | Pb | Zn |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (cm) | | | | | | | (mg/kg) | | | | | | | |
| 0-5 | 1104 | 741 | 395 | 46 | 5285 | 5.5 | 0.4 | 11.5 | 4.5 | 8260 | 272 | 3.3 | 17.7 | 21.0 |
| 5-10 | 569 | 837 | 291 | 37 | 6379 | 4.5 | 0.3 | 5.1 | 3.1 | 9942 | 191 | 4.4 | 8.7 | 18.2 |
| 10-15 | 702 | 1043 | 302 | 43 | 7935 | 4.7 | 0.4 | 4.4 | 3.8 | 9962 | 132 | 6.5 | 9.0 | 22.2 |
| 15-20 | 674 | 1165 | 327 | 44 | 9567 | 5.2 | 0.2 | 6.0 | 4.8 | 11319 | 102 | 8.5 | 9.7 | 22.6 |
| 20-25 | 737 | 1266 | 373 | 47 | 9637 | 5.4 | 0.1 | 8.9 | 5.3 | 11606 | 91 | 8.1 | 11.0 | 19.0 |
| 25-30 | 937 | 1250 | 334 | 46 | 8837 | 5.0 | 0.3 | 7.0 | 5.3 | 10383 | 81 | 7.3 | 9.8 | 15.9 |
| 30-35 | 848 | 1390 | 341 | 47 | 8992 | 5.4 | 0.8 | 7.9 | 6.1 | 11660 | 79 | 8.2 | 10.2 | 16.3 |
| 35-40 | 792 | 1385 | 329 | 45 | 8050 | 5.2 | 0.6 | 6.9 | 6.0 | 10614 | 76 | 7.6 | 9.6 | 14.6 |
| 40-45 | 736 | 1380 | 317 | 42 | 7109 | 5.0 | 0.4 | 5.9 | 6.0 | 9566 | 72 | 6.9 | 9.1 | 12.8 |
| 45-50 | 710 | 1260 | 297 | 42 | 6713 | 4.6 | 0.3 | 7.3 | 5.9 | 9501 | 70 | 6.6 | 8.6 | 11.6 |
| 50-55 | 709 | 1150 | 266 | 40 | 5660 | 4.4 | 0.3 | 4.9 | 5.5 | 8396 | 63 | 5.5 | 7.4 | 8.8 |
| 55-60 | 683 | 1114 | 275 | 35 | 4584 | 3.9 | 0.4 | 4.1 | 4.9 | 6692 | 54 | 5.5 | 6.5 | 7.7 |
| 60-65 | 996 | 1216 | 259 | 42 | 4048 | 3.9 | 0.4 | 3.6 | 4.8 | 6258 | 66 | 4.4 | 6.3 | 7.6 |
| 65-70 | 941 | 1366 | 264 | 34 | 4056 | 3.8 | 0.2 | 4.3 | 5.6 | 7058 | 75 | 5.6 | 6.7 | 8.8 |
| 70-75 | 983 | 1144 | 259 | 89 | 3937 | 4.3 | 0.1 | 3.7 | 5.0 | 5600 | 62 | 4.4 | 6.3 | 6.8 |
| 75-80 | 929 | 1490 | 300 | 66 | 4484 | 4.7 | 0.3 | 4.4 | 6.4 | 7630 | 77 | 5.5 | 7.9 | 9.2 |
| 80-85 | 1075 | 1836 | 333 | 44 | 5032 | 5.0 | 0.5 | 5.0 | 7.8 | 9660 | 107 | 6.6 | 9.0 | 11.5 |
| 85-90 | 1553 | 1998 | 370 | 78 | 5584 | 5.1 | 0.6 | 6.2 | 6.9 | 8768 | 85 | 8.0 | 8.9 | 10.7 |
| 90-95 | 1751 | 1547 | 283 | 41 | 4603 | 3.5 | 0.6 | 4.4 | 5.8 | 7380 | 132 | 6.8 | 7.3 | 8.7 |
| 95-100 | 1184 | 1576 | 260 | 44 | 4326 | 3.9 | 0.5 | 4.2 | 7.5 | 7877 | 91 | 5.7 | 7.5 | 9.4 |
| 100-105 | 1222 | 2171 | 342 | 47 | 5297 | 4.1 | 0.3 | 4.4 | 7.7 | 8896 | 88 | 7.2 | 9.5 | 11.7 |
| 105-110 | 978 | 1437 | 271 | 35 | 3948 | 4.4 | 0.2 | 5.7 | 5.9 | 6823 | 66 | 5.9 | 7.1 | 8.0 |
| 110-115 | 1300 | 1647 | 275 | 40 | 4355 | 4.3 | 0.3 | 4.7 | 7.4 | 7697 | 84 | 5.7 | 7.5 | 9.7 |
| 115-120 | 1655 | 2064 | 307 | 40 | 5263 | 4.8 | 0.4 | 7.8 | 8.2 | 8914 | 92 | 8.0 | 8.8 | 11.5 |
| 120-125 | 2010 | 2481 | 339 | 39 | 6171 | 5.2 | 0.5 | 10.9 | 8.9 | 10132 | 99 | 10.1 | 10.2 | 13.3 |
| 125-130 | 1579 | 1601 | 287 | 102 | 4672 | 4.3 | 0.3 | 4.5 | 6.7 | 6708 | 79 | 6.0 | 7.4 | 7.9 |
| 130-135 | 1455 | 2392 | 447 | 58 | 6391 | 7.6 | 0.9 | 6.8 | 12.5 | 11525 | 155 | 9.4 | 12.4 | 15.3 |
| 135-140 | 801 | 1037 | 210 | 31 | 3205 | 3.3 | 0.2 | 2.8 | 4.5 | 5955 | 74 | 3.7 | 5.9 | 6.7 |
| 140-145 | 1055 | 1334 | 241 | 36 | 3714 | 3.4 | 0.2 | 4.2 | 5.1 | 5813 | 81 | 4.6 | 6.8 | 6.5 |
| 145-150 | 1337 | 1131 | 245 | 28 | 3534 | 3.5 | 0.4 | 3.5 | 4.6 | 5689 | 83 | 4.3 | 6.3 | 6.1 |

| Depth | As | Ba | Be | Co | Li | Mo | Sr | Ti | V |
|---|---|---|---|---|---|---|---|---|---|
| (cm) | | | | | (mg/kg) | | | | |
| 0-5 | 7.9 | 102 | .25 | 4.2 | 3.2 | 2.6 | 14.9 | 701 | 27.2 |
| 5-10 | | | | | | | | | |
| 10-15 | | | | | | | | | |
| 15-20 | | | | | | | | | |
| 20-25 | 12.4 | 53 | .41 | 5.9 | 6.0 | 3.9 | 11.4 | 823 | 35.0 |
| 25-30 | 11.4 | 54 | .40 | 5.6 | 5.6 | 3.8 | 12.8 | 752 | 31.3 |
| 30-35 | 10.2 | 53 | .34 | 5.1 | 5.2 | 3.3 | 11.8 | 632 | 25.6 |
| 35-40 | 9.6 | 48 | .35 | 4.7 | 4.5 | 3.1 | 10.5 | 577 | 24.9 |
| 40-45 | 9.1 | 45 | .35 | 5.3 | 4.5 | 3.2 | 11.2 | 731 | 29.4 |
| 45-50 | 9.7 | 43 | .37 | 5.5 | 4.4 | 3.3 | 12.6 | 680 | 29.4 |
| 50-55 | 7.4 | 68 | .28 | 4.1 | 3.4 | 2.5 | 10.7 | 449 | 17.6 |
| 55-60 | 7.6 | 30 | .31 | 4.8 | 3.6 | 2.4 | 12.0 | 598 | 23.7 |
| 60-65 | 6.6 | 23 | .26 | 3.8 | 3.3 | 2.1 | 17.0 | 307 | 18.1 |
| 65-70 | 6.0 | 25 | .25 | 4.0 | 3.6 | 2.0 | 11.3 | 413 | 15.3 |
| 70-75 | 6.8 | 25 | .25 | 4.5 | 3.6 | 2.1 | 11.5 | 401 | 18.3 |
| 75-80 | 7.0 | 30 | .26 | 4.7 | 4.2 | 2.3 | 13.2 | 467 | 19.5 |
| 80-85 | 10.7 | 67 | .41 | 6.2 | 11.2 | 3.4 | 19.5 | 413 | 23.9 |
| 85-90 | 10.2 | 54 | .39 | 6.7 | 5.7 | 3.3 | 17.8 | 502 | 30.7 |
| 90-95 | 10.1 | 42 | .36 | 6.5 | 6.8 | 3.1 | 19.5 | 713 | 26.3 |
| 95-100 | 8.0 | 33 | .32 | 5.5 | 4.6 | 3.2 | 12.7 | 681 | 22.9 |
| 100-105 | 10.5 | 38 | .33 | 6.9 | 6.0 | 3.2 | 16.3 | 726 | 31.3 |
| 105-110 | 8.2 | 36 | .31 | 5.0 | 4.5 | 2.6 | 9.1 | 391 | 23.7 |
| 110-115 | 9.5 | 46 | .40 | 6.9 | 8.4 | 3.2 | 12.8 | 606 | 25.9 |
| 115-120 | 8.1 | 35 | .29 | 5.4 | 5.3 | 2.7 | 11.8 | 447 | 21.0 |
| 120-125 | 7.4 | 49 | .27 | 4.4 | 3.7 | 2.4 | 11.3 | 493 | 17.8 |
| 125-130 | 8.4 | 31 | .33 | 5.8 | 4.4 | 2.7 | 11.5 | 594 | 22.7 |
| 130-135 | 6.4 | 23 | .25 | 4.1 | 3.5 | 2.1 | 10.8 | 374 | 14.4 |
| 135-140 | 7.9 | 33 | .30 | 5.0 | 5.6 | 2.7 | 12.9 | 459 | 22.1 |
| 140-145 | 7.9 | 32 | .30 | 5.2 | 5.8 | 2.5 | 15.9 | 500 | 21.5 |
| 145-150 | 4.5 | 24 | .19 | 3.2 | 2.8 | 1.6 | 9.0 | 309 | 12.8 |

Appendix 5. (Continued). Site 2

| Depth | Ca | Mg | K | Na | Al | B | Cd | Cr | Cu | Fe | Mn | Ni | Pb | Zn |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (cm) | (mg/kg) | | | | | | | | | | | | | |
| 0-5 | 701 | 488 | 298 | 33 | 3764 | 3.5 | 0.3 | 4.4 | 2.6 | 4873 | 165 | 2.2 | 9.5 | 21.7 |
| 5-10 | 600 | 393 | 256 | 37 | 3834 | 3.6 | 0.5 | 3.6 | 1.9 | 4588 | 131 | 1.8 | 6.5 | 16.8 |
| 10-15 | 581 | 410 | 251 | 34 | 4038 | 3.5 | 0.4 | 3.7 | 1.8 | 4898 | 137 | 1.8 | 5.9 | 13.6 |
| 15-20 | 563 | 428 | 245 | 32 | 4243 | 3.3 | 0.3 | 3.7 | 1.7 | 5208 | 144 | 1.8 | 5.3 | 10.4 |
| 20-25 | 670 | 643 | 308 | 47 | 6287 | 3.9 | 0.3 | 3.8 | 2.3 | 7500 | 150 | 2.9 | 6.6 | 12.4 |
| 25-30 | 629 | 798 | 321 | 44 | 7224 | 4.4 | 0.3 | 3.7 | 2.6 | 7894 | 118 | 4.3 | 7.6 | 14.9 |
| 30-35 | 833 | 977 | 335 | 47 | 8109 | 4.4 | 0.4 | 4.2 | 3.3 | 8493 | 110 | 5.6 | 8.2 | 16.5 |
| 35-40 | 786 | 1370 | 364 | 51 | 9170 | 5.4 | 0.6 | 5.4 | 4.1 | 9913 | 101 | 7.7 | 9.4 | 20.0 |
| 40-45 | 737 | 1250 | 282 | 44 | 6589 | 4.5 | 0.4 | 5.0 | 3.6 | 7635 | 74 | 6.7 | 7.5 | 15.3 |
| 45-50 | 614 | 1100 | 297 | 43 | 6476 | 4.8 | 0.5 | 5.3 | 4.3 | 7106 | 73 | 6.5 | 7.0 | 16.9 |
| 50-55 | 719 | 1151 | 289 | 40 | 6048 | 5.0 | 0.4 | 5.8 | 4.0 | 7087 | 67 | 6.1 | 6.9 | 15.55 |
| 55-60 | 804 | 1210 | 281 | 36 | 5260 | 5.2 | 0.4 | 6.2 | 3.7 | 7068 | 62 | 5.8 | 6.9 | 14.1 |
| 60-65 | 792 | 1118 | 279 | 30 | 4750 | 4.3 | 0.2 | 4.4 | 3.4 | 6189 | 48 | 4.8 | 5.7 | 9.8 |
| 65-70 | 629 | 1096 | 290 | 30 | 4480 | 4.9 | 0.2 | 4.8 | 3.4 | 6556 | 47 | 5.0 | 5.7 | 8.5 |
| 70-75 | 662 | 1134 | 274 | 32 | 4080 | 4.2 | 0.2 | 3.6 | 3.3 | 5799 | 52 | 4.8 | 5.7 | 8.6 |
| 75-80 | 743 | 1251 | 287 | 40 | 4250 | 5.1 | 0.3 | 3.7 | 4.3 | 7079 | 62 | 5.1 | 6.5 | 8.8 |
| 80-85 | 663 | 1378 | 303 | 38 | 4230 | 5.2 | 0.5 | 3.5 | 4.4 | 6442 | 52 | 5.3 | 6.2 | 7.7 |
| 85-90 | 948 | 1850 | 369 | 56 | 6430 | 6.4 | 0.1 | 6.8 | 6.3 | 9398 | 70 | 7.5 | 9.3 | 10.5 |
| 90-95 | 1056 | 2142 | 458 | 62 | 7990 | 8.5 | 0.3 | 7.8 | 9.0 | 11205 | 81 | 9.7 | 10.8 | 13.1 |
| 95-100 | 1163 | 2435 | 548 | 68 | 9550 | 10.6 | 0.4 | 8.9 | 12.3 | 13012 | 93 | 10.0 | 12.3 | 15.8 |
| 100-105 | 1609 | 1604 | 377 | 46 | 6250 | 5.9 | 0.3 | 6.4 | 5.4 | 9771 | 79 | 7.1 | 8.7 | 10.2 |
| 105-110 | 789 | 1532 | 324 | 50 | 5600 | 6.2 | 0.4 | 6.0 | 5.5 | 8329 | 74 | 6.7 | 7.9 | 10.0 |
| 110-115 | 985 | 1814 | 402 | 52 | 6600 | 6.1 | 0.4 | 6.7 | 6.7 | 8578 | 72 | 7.3 | 8.8 | 10.8 |
| 115-120 | 908 | 1520 | 330 | 42 | 5350 | 6.0 | 0.3 | 5.4 | 5.3 | 8350 | 66 | 6.5 | 7.2 | 9.1 |
| 120-125 | 915 | 1740 | 378 | 52 | 6950 | 6.1 | 0.3 | 5.7 | 7.1 | 9130 | 79 | 7.5 | 9.0 | 11.7 |
| 125-130 | 913 | 2230 | 590 | 73 | 9930 | 8.2 | 0.5 | 7.9 | 13.0 | 11500 | 81 | 8.9 | 11.7 | 15.1 |
| 130-135 | 975 | 2212 | 552 | 69 | 9406 | 7.8 | 0.5 | 8.4 | 11.9 | 11737 | 86 | 8.8 | 11.2 | 14.8 |
| 135-140 | 1037 | 2194 | 515 | 65 | 8882 | 7.3 | 0.5 | 9.0 | 10.9 | 11974 | 90 | 8.8 | 10.7 | 14.5 |
| 140-145 | 707 | 1560 | 363 | 45 | 6673 | 5.5 | 0.2 | 6.3 | 9.5 | 9091 | 73 | 7.2 | 7.8 | 11.6 |
| 145-150 | 841 | 2090 | 468 | 64 | 8280 | 6.4 | 0.4 | 5.9 | 10.4 | 10898 | 79 | 7.8 | 9.4 | 14.6 |

| Depth | As | Ba | Be | Co | Li | Mo | Sr | Ti | V |
|---|---|---|---|---|---|---|---|---|---|
| (cm) | (mg/kg) | | | | | | | | |
| 0-5 | | | | | | | | | |
| 5-10 | | | | | | | | | |
| 10-15 | | | | | | | | | |
| 15-20 | | | | | | | | | |
| 20-25 | | | | | | | | | |
| 25-30 | 9.4 | 53 | .30 | 5.0 | 5.0 | 3.2 | 11.4 | 616 | 24.1 |
| 30-35 | 9.3 | 52 | .28 | 4.4 | 5.4 | 3.2 | 12.2 | 537 | 23.4 |
| 35-40 | 9.6 | 54 | .32 | 5.0 | 5.6 | 3.3 | 10.7 | 574 | 22.0 |
| 40-45 | 8.2 | 44 | .29 | 4.4 | 4.5 | 2.8 | 12.9 | 483 | 19.8 |
| 45-50 | 7.2 | 37 | .27 | 4.1 | 3.7 | 2.4 | 10.6 | 443 | 18.6 |
| 50-55 | 7.6 | 43 | .28 | 4.4 | 4.1 | 2.6 | 8.7 | 470 | 19.3 |
| 55-60 | 8.2 | 41 | .30 | 5.2 | 4.7 | 2.8 | 10.1 | 556 | 24.0 |
| 60-65 | 7.4 | 36 | .28 | 3.8 | 3.2 | 2.3 | 13.1 | 428 | 18.6 |
| 65-70 | 6.5 | 27 | .26 | 4.1 | 3.3 | 2.1 | 11.8 | 318 | 14.6 |
| 70-75 | 7.0 | 31 | .25 | 4.5 | 4.0 | 2.2 | 12.7 | 370 | 15.4 |
| 75-80 | 7.4 | 30 | .26 | 4.9 | 3.6 | 2.2 | 8.2 | 467 | 20.3 |
| 80-85 | 6.4 | 30 | .25 | 4.4 | 3.8 | 2.1 | 9.4 | 399 | 18.9 |
| 85-90 | 9.9 | 57 | .37 | 5.9 | 4.8 | 3.2 | 13.7 | 766 | 31.8 |
| 90-95 | 4.2 | 77 | .44 | 5.3 | 6.8 | 4.0 | 17.1 | 769 | 32.3 |
| 95-100 | 4.8 | 71 | .44 | 5.9 | 6.5 | 4.2 | 14.9 | 802 | 38.4 |
| 100-105 | 5.4 | 40 | .34 | 5.2 | 4.9 | 3.0 | 15.7 | 591 | 27.7 |
| 105-110 | 2.9 | 36 | .27 | 4.0 | 4.4 | 2.3 | 9.2 | 500 | 20.1 |
| 110-115 | | | | | | | | | |
| 115-120 | 2.9 | 32 | .27 | 4.2 | 4.2 | 2.3 | 9.3 | 421 | 21.2 |
| 120-125 | 4.0 | 51 | .32 | 4.4 | 4.8 | 2.9 | 11.2 | 645 | 26.0 |
| 125-130 | 5.1 | 70 | .44 | 5.1 | 6.5 | 4.0 | 15.2 | 850 | 38.1 |
| 130-135 | 4.3 | 86 | .46 | 5.8 | 7.3 | 4.3 | 17.2 | 725 | 32.1 |
| 135-140 | 4.2 | 61 | .36 | 4.7 | 5.2 | 3.2 | 12.0 | 732 | 30.6 |

Appendix 5. (Continued). Site 3

| Depth | Ca | Mg | K | Na | Al | B | Cd | Cr | Cu | Fe | Mn | Ni | Pb | Zn |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (cm) | | | | | | | (mg/kg) | | | | | | | |
| 0-5 | 2423 | 1591 | 619 | 94 | 9554 | 4.8 | 0.3 | 8.6 | 6.8 | 8229 | 557 | 8.8 | 18.8 | 50.2 |
| 5-10 | 1839 | 1167 | 480 | 104 | 8742 | 4.6 | 0.3 | 6.7 | 4.7 | 6526 | 510 | 5.7 | 9.9 | 40.0 |
| 10-15 | 1435 | 1377 | 486 | 106 | 10840 | 4.7 | 0.1 | 6.9 | 4.2 | 8396 | 141 | 7.3 | 8.9 | 34.6 |
| 15-20 | 1571 | 1768 | 522 | 107 | 12692 | 4.8 | 0.2 | 8.7 | 5.2 | 10110 | 113 | 11.0 | 10.1 | 34.5 |
| 20-25 | 1839 | 2010 | 608 | 122 | 13952 | 4.8 | 0.1 | 8.9 | 6.2 | 10673 | 118 | 13.3 | 10.3 | 28.1 |
| 25-30 | 1967 | 2164 | 590 | 122 | 13190 | 4.7 | 0.3 | 9.0 | 6.6 | 10322 | 119 | 13.1 | 10.2 | 23.9 |
| 30-35 | 2137 | 2246 | 599 | 127 | 12423 | 4.8 | 0.3 | 7.1 | 7.4 | 9997 | 110 | 12.8 | 10.7 | 21.7 |
| 35-40 | 1787 | 1979 | 497 | 113 | 9739 | 4.0 | 0.6 | 9.0 | 6.6 | 8108 | 88 | 10.3 | 8.3 | 15.9 |
| 40-45 | 2008 | 2207 | 540 | 125 | 9979 | 4.3 | 0.4 | 7.1 | 7.4 | 8650 | 99 | 11.6 | 9.3 | 16.1 |
| 45-50 | 1789 | 2091 | 498 | 112 | 8420 | 3.9 | 0.2 | 6.7 | 6.9 | 7650 | 84 | 10.4 | 8.2 | 13.8 |
| 50-55 | 1817 | 2123 | 563 | 118 | 8093 | 3.8 | 0.1 | 6.0 | 6.9 | 7530 | 93 | 10.3 | 7.9 | 13.4 |
| 55-60 | 1826 | 2234 | 599 | 117 | 8045 | 3.7 | 0.2 | 7.6 | 7.2 | 7730 | 98 | 11.0 | 8.4 | 14.0 |
| 60-65 | 1765 | 2266 | 613 | 112 | 7839 | 3.8 | 0.3 | 6.6 | 7.2 | 7530 | 101 | 11.1 | 8.1 | 14.9 |
| 65-70 | 1794 | 2498 | 692 | 119 | 8774 | 3.8 | 0.4 | 6.3 | 8.1 | 8250 | 112 | 11.9 | 9.0 | 16.0 |
| 70-75 | 1872 | 2299 | 634 | 117 | 8058 | 3.6 | 0.4 | 6.1 | 7.1 | 7930 | 102 | 11.0 | 8.0 | 14.9 |
| 75-80 | 1761 | 1909 | 532 | 108 | 6780 | 3.3 | 0.2 | 5.4 | 6.4 | 7100 | 98 | 9.4 | 7.3 | 12.5 |
| 80-85 | 1929 | 2030 | 550 | 123 | 6562 | 3.5 | 0.1 | 5.7 | 6.3 | 7180 | 101 | 9.5 | 7.5 | 12.4 |
| 85-90 | 1639 | 1881 | 510 | 100 | 5889 | 2.7 | 0.4 | 4.0 | 5.5 | 6100 | 84 | 8.6 | 6.4 | 11.3 |
| 90-95 | 1906 | 2103 | 587 | 106 | 6592 | 3.4 | 0.4 | 6.3 | 6.2 | 7180 | 107 | 9.5 | 7.8 | 13.0 |
| 95-100 | 1796 | 2065 | 556 | 102 | 6183 | 3.0 | 0.3 | 5.4 | 5.8 | 7050 | 99 | 8.9 | 7.1 | 13.0 |
| 100-105 | 1779 | 2115 | 504 | 100 | 6402 | 3.6 | 0.2 | 8.0 | 6.2 | 7203 | 101 | 9.8 | 7.4 | 13.1 |
| 105-110 | 1967 | 2140 | 552 | 110 | 6777 | 3.7 | 0.2 | 7.1 | 6.3 | 7387 | 107 | 10.0 | 7.3 | 13.5 |
| 110-115 | 1686 | 2094 | 524 | 101 | 6207 | 3.0 | 0.2 | 4.9 | 6.3 | 6910 | 98 | 9.8 | 7.4 | 13.8 |
| 115-120 | 1715 | 2190 | 520 | 100 | 6334 | 3.9 | 0.2 | 4.9 | 6.4 | 7113 | 104 | 10.1 | 7.2 | 13.2 |
| 120-125 | 1644 | 2256 | 558 | 105 | 6641 | 3.0 | 0.2 | 4.7 | 6.4 | 6916 | 101 | 10.1 | 7.8 | 13.9 |
| 125-130 | 1712 | 2190 | 540 | 111 | 6637 | 4.6 | 0.3 | 5.3 | 6.6 | 7200 | 103 | 10.4 | 7.7 | 13.5 |
| 130-135 | 1930 | 1931 | 498 | 105 | 6045 | 3.8 | 0.2 | 7.3 | 5.9 | 7203 | 104 | 9.0 | 7.4 | 12.3 |
| 135-140 | 1809 | 2118 | 526 | 106 | 6391 | 3.7 | 0.2 | 6.5 | 6.0 | 7126 | 94 | 9.6 | 7.3 | 13.3 |
| 140-145 | 1808 | 1848 | 436 | 97 | 5408 | 3.4 | 0.2 | 6.5 | 5.9 | 6778 | 100 | 8.6 | 6.5 | 11.6 |

| Depth | As | Ba | Be | Co | Li | Mo | Sr | Ti | V |
|---|---|---|---|---|---|---|---|---|---|
| (cm) | | | | | (mg/kg) | | | | |
| 0-5 | 2.9 | 205 | .44 | 4.5 | 7.8 | 3.8 | 35.3 | 532 | 19.6 |
| 5-10 | 2.6 | 202 | .39 | 3.4 | 6.4 | 3.5 | 32.8 | 600 | 18.9 |
| 10-15 | 2.8 | 173 | .49 | 4.8 | 10.0 | 4.5 | 29.2 | 765 | 24.8 |
| 15-20 | 2.6 | 115 | .50 | 5.2 | 10.9 | 4.7 | 29.2 | 602 | 22.5 |
| 20-25 | 2.7 | 97 | .53 | 5.4 | 10.9 | 4.9 | 25.7 | 582 | 22.1 |
| 25-30 | 2.9 | 82 | .53 | 5.7 | 11.0 | 4.8 | 28.6 | 558 | 22.8 |
| 30-35 | 2.5 | 68 | .50 | 5.4 | 9.7 | 4.1 | 25.3 | 546 | 20.8 |
| 35-40 | 2.9 | 67 | .54 | 5.7 | 10.0 | 4.0 | 29.2 | 572 | 21.8 |
| 40-45 | 2.6 | 57 | .49 | 5.4 | 9.1 | 3.6 | 25.4 | 535 | 20.4 |
| 45-50 | 2.1 | 54 | .49 | 5.6 | 9.3 | 3.4 | 28.3 | 526 | 20.4 |
| 50-55 | 2.4 | 50 | .46 | 5.2 | 9.0 | 3.2 | 23.9 | 560 | 19.1 |
| 55-60 | 2.2 | 56 | .44 | 5.1 | 9.9 | 3.1 | 25.3 | 444 | 17.4 |
| 60-65 | 2.3 | 57 | .47 | 5.6 | 10.7 | 3.3 | 23.8 | 473 | 18.5 |
| 65-70 | 2.5 | 66 | .51 | 6.0 | 11.7 | 3.5 | 26.3 | 483 | 18.9 |
| 70-75 | 2.3 | 55 | .47 | 5.4 | 10.5 | 3.1 | 23.4 | 468 | 18.9 |
| 75-80 | 2.2 | 54 | .42 | 5.2 | 9.0 | 2.9 | 23.0 | 434 | 18.0 |
| 80-85 | 2.4 | 55 | .44 | 5.5 | 9.1 | 2.9 | 26.5 | 542 | 21.1 |
| 85-90 | 2.3 | 59 | .41 | 5.3 | 9.2 | 2.8 | 24.0 | 506 | 17.9 |
| 90-95 | 1.7 | 64 | .42 | 4.9 | 9.3 | 2.8 | 23.8 | 449 | 17.0 |
| 95-100 | 1.9 | 61 | .40 | 4.8 | 8.9 | 2.5 | 25.5 | 455 | 16.9 |

Appendix 5. (Continued). Site 4

| Depth | Ca | Mg | K | Na | Al | B | Cd | Cr | Cu | Fe | Mn | Ni | Pb | Zn |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (cm) | | | | | | | (mg/kg) | | | | | | | |
| 0-5 | 293 | 621 | 267 | 30 | 4532 | 4.1 | 0.3 | 5.5 | 2.6 | 7384 | 165 | 2.9 | 11.5 | 15.5 |
| 5-10 | 196 | 554 | 204 | 25 | 3715 | 3.8 | 0.4 | 5.4 | 2.0 | 6684 | 138 | 2.2 | 7.2 | 12.1 |
| 10-15 | 248 | 625 | 260 | 33 | 4983 | 4.0 | 0.2 | 5.8 | 2.0 | 9403 | 98 | 2.5 | 6.6 | 10.8 |
| 15-20 | 211 | 732 | 259 | 31 | 6839 | 4.0 | 0.2 | 5.3 | 2.5 | 10307 | 93 | 3.7 | 7.2 | 12.8 |
| 20-25 | 230 | 835 | 286 | 34 | 8397 | 6.1 | 0.2 | 5.7 | 3.2 | 10611 | 96 | 5.5 | 7.1 | 16.3 |
| 25-30 | 191 | 745 | 251 | 27 | 6999 | 3.8 | 0.2 | 5.4 | 3.1 | 8161 | 67 | 5.4 | 5.7 | 12.7 |
| 30-35 | 204 | 751 | 220 | 28 | 5889 | 3.6 | 0.2 | 4.6 | 3.1 | 7327 | 58 | 4.7 | 5.2 | 10.1 |
| 35-40 | 216 | 757 | 188 | 28 | 4799 | 3.4 | 0.2 | 3.9 | 3.1 | 6493 | 49 | 4.1 | 4.7 | 7.5 |
| 40-45 | 462 | 870 | 225 | 35 | 4852 | 4.0 | 0.3 | 4.8 | 3.6 | 8099 | 60 | 4.3 | 5.3 | 7.8 |
| 45-50 | 342 | 728 | 206 | 31 | 3850 | 3.4 | 0.1 | 7.0 | 3.2 | 7169 | 59 | 3.5 | 4.4 | 6.5 |
| 50-55 | 342 | 688 | 177 | 26 | 3047 | 3.1 | 0.2 | 3.0 | 3.0 | 6349 | 55 | 3.1 | 4.1 | 5.6 |
| 55-60 | 349 | 665 | 190 | 34 | 3150 | 3.0 | 0.2 | 3.3 | 3.2 | 6401 | 53 | 3.0 | 4.1 | 5.4 |
| 60-65 | 423 | 755 | 200 | 36 | 3424 | 3.1 | 0.2 | 3.9 | 3.7 | 6273 | 57 | 3.2 | 4.1 | 5.4 |
| 65-70 | 438 | 805 | 210 | 40 | 3305 | 3.4 | 0.2 | 4.3 | 3.8 | 6576 | 65 | 3.4 | 4.6 | 5.7 |
| 70-75 | 730 | 735 | 184 | 36 | 3106 | 3.0 | 0.1 | 3.4 | 3.3 | 5454 | 62 | 2.7 | 6.0 | 4.9 |
| 75-80 | 693 | 1010 | 274 | 53 | 4269 | 3.9 | 0.2 | 5.3 | 4.6 | 8691 | 81 | 4.0 | 5.7 | 7.7 |
| 80-85 | 507 | 768 | 220 | 50 | 3009 | 3.1 | 0.1 | 3.9 | 3.5 | 6432 | 68 | 3.0 | 4.1 | 5.9 |
| 85-90 | 420 | 705 | 217 | 40 | 2847 | 3.1 | 0.2 | 3.6 | 3.4 | 6282 | 72 | 2.7 | 3.9 | 5.0 |
| 90-95 | 360 | 673 | 183 | 41 | 2574 | 2.6 | 0.1 | 2.7 | 3.1 | 5103 | 59 | 2.4 | 3.4 | 4.7 |
| 95-100 | 352 | 618 | 173 | 33 | 2292 | 2.5 | 0.2 | 2.9 | 2.7 | 5105 | 53 | 2.2 | 3.4 | 5.0 |
| 100-105 | 502 | 810 | 219 | 45 | 2916 | 3.3 | 0.2 | 4.5 | 3.2 | 6508 | 63 | 2.9 | 4.2 | 6.5 |
| 105-110 | 371 | 748 | 190 | 34 | 2485 | 2.7 | 0.3 | 4.1 | 2.7 | 5509 | 55 | 3.2 | 3.7 | 5.8 |
| 110-115 | 443 | 758 | 185 | 40 | 2760 | 3.2 | 0.3 | 3.9 | 3.2 | 6843 | 69 | 2.9 | 4.1 | 5.4 |
| 115-120 | 555 | 836 | 228 | 46 | 2905 | 3.5 | 0.2 | 4.5 | 3.4 | 7617 | 70 | 3.1 | 4.6 | 6.5 |
| 120-125 | 430 | 664 | 163 | 30 | 2367 | 2.5 | 0.2 | 3.3 | 2.7 | 5514 | 58 | 2.4 | 3.7 | 4.9 |
| 125-130 | 443 | 758 | 186 | 41 | 2967 | 2.9 | 0.1 | 3.8 | 3.3 | 6418 | 63 | 2.8 | 4.4 | 6.5 |

| Depth | As | Ba | Be | Co | Li | Mo | Sr | Ti | V |
|---|---|---|---|---|---|---|---|---|---|
| (cm) | | | | | (mg/kg) | | | | |
| 0-5 | 5.1 | 77 | .31 | 2.9 | 3.3 | 2.6 | 13.7 | 763 | 26.4 |
| 5-10 | 3.6 | 87 | .26 | 2.3 | 2.1 | 2.0 | 11.5 | 662 | 19.6 |
| 10-15 | 3.3 | 40 | .23 | 2.1 | 2.7 | 1.9 | 11.7 | 582 | 20.0 |
| 15-20 | 5.5 | 57 | .42 | 3.9 | 5.5 | 3.7 | 12.2 | 877 | 36.5 |
| 20-25 | 5.0 | 52 | .43 | 4.6 | 6.2 | 4.1 | 10.6 | 944 | 36.0 |
| 25-30 | 4.0 | 48 | .43 | 3.5 | 4.7 | 3.4 | 10.3 | 557 | 24.1 |
| 30-35 | 3.4 | 39 | .38 | 3.6 | 4.0 | 2.9 | 9.5 | 690 | 24.1 |
| 35-40 | 3.6 | 28 | .34 | 3.3 | 2.9 | 2.4 | 9.3 | 610 | 23.3 |
| 40-45 | | | | | | | | | |
| 45-50 | 3.1 | 21 | .32 | 3.0 | 2.1 | 1.8 | 8.8 | 698 | 24.8 |
| 50-55 | 3.4 | 20 | .28 | 2.5 | 1.7 | 1.6 | 10.3 | 478 | 19.5 |
| 55-60 | 2.6 | 19 | .28 | 2.5 | 1.7 | 1.5 | 9.5 | 663 | 22.7 |
| 60-65 | 2.7 | 16 | .22 | 1.8 | 1.3 | 1.2 | 10.6 | 383 | 13.7 |
| 65-70 | 2.7 | 17 | .24 | 2.1 | 1.6 | 1.2 | 9.0 | 444 | 15.7 |
| 70-75 | 3.3 | 18 | .28 | 2.6 | 1.7 | 1.6 | 10.1 | 603 | 23.6 |
| 75-80 | 3.1 | 18 | .26 | 2.4 | 1.6 | 1.4 | 9.7 | 473 | 22.6 |
| 80-85 | 3.4 | 19 | .26 | 2.3 | 1.7 | 1.3 | 12.2 | 453 | 17.2 |
| 85-90 | 4.0 | 19 | .31 | 2.9 | 1.8 | 1.7 | 10.5 | 655 | 26.6 |
| 90-95 | 3.3 | 18 | .27 | 2.4 | 1.8 | 1.5 | 10.0 | 534 | 20.0 |
| 95-100 | 4.2 | 18 | .29 | 2.2 | 1.6 | 1.3 | 12.2 | 534 | 19.6 |
| 100-105 | 3.2 | 35 | .28 | 2.6 | 1.9 | 1.4 | 10.8 | 402 | 17.2 |
| 105-110 | 2.3 | 15 | .24 | 2.1 | 1.5 | 1.2 | 8.6 | 370 | 17.6 |
| 110-115 | 2.9 | 18 | .26 | 2.4 | 1.6 | 1.3 | 9.0 | 426 | 22.3 |
| 115-120 | 2.6 | 14 | .19 | 1.7 | 1.3 | .9 | 9.4 | 243 | 13.0 |
| 120-125 | 2.9 | 16 | .24 | 2.2 | 1.5 | 1.3 | 8.6 | 378 | 22.1 |
| 125-130 | 3.0 | 23 | .23 | 2.3 | 1.4 | 1.2 | 9.4 | 320 | 19.5 |

Appendix 5. (Continued). Site 5

| Depth | Ca | Mg | K | Na | Al | B | Cd | Cr | Cu | Fe | Mn | Ni | Pb | Zn |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (cm) | | | | | | | (mg/kg) | | | | | | | |
| 0-5 | 226 | 300 | 169 | 17 | 2568 | 2.6 | 0.2 | 3.3 | 1.9 | 6049 | 63 | 1.6 | 7.4 | 9.2 |
| 5-10 | 167 | 258 | 166 | 15 | 2546 | 2.4 | 0.2 | 3.6 | 1.5 | 6121 | 42 | 1.4 | 6.0 | 6.9 |
| 10-15 | 189 | 295 | 172 | 18 | 2887 | 2.9 | 0.3 | 5.6 | 1.8 | 8181 | 49 | 1.9 | 5.4 | 7.6 |
| 15-20 | 173 | 451 | 172 | 20 | 4803 | 3.0 | 0.2 | 5.3 | 1.9 | 8816 | 44 | 2.9 | 4.9 | 8.6 |
| 20-25 | 262 | 650 | 189 | 54 | 5828 | 3.7 | 0.2 | 5.2 | 2.5 | 8869 | 49 | 4.7 | 5.3 | 8.3 |
| 25-30 | 352 | 850 | 206 | 87 | 6852 | 4.4 | 0.2 | 5.2 | 3.2 | 8922 | 54 | 6.6 | 5.7 | 8.0 |
| 30-35 | 568 | 516 | 165 | 25 | 4461 | 2.9 | 0.3 | 3.1 | 2.1 | 5377 | 37 | 3.7 | 3.5 | 5.1 |
| 35-40 | 165 | 404 | 101 | 21 | 3048 | 2.4 | 0.1 | 2.1 | 2.0 | 4237 | 33 | 2.8 | 2.9 | 3.4 |
| 40-45 | 284 | 520 | 142 | 36 | 3296 | 2.7 | 0.3 | 3.4 | 2.2 | 7255 | 55 | 3.6 | 3.7 | 5.2 |
| 45-50 | 289 | 443 | 116 | 30 | 2525 | 2.5 | 0.2 | 2.8 | 2.0 | 6262 | 49 | 2.9 | 3.1 | 4.6 |
| 50-55 | 357 | 418 | 125 | 43 | 2384 | 2.8 | 0.1 | 3.7 | 2.2 | 7351 | 52 | 2.8 | 3.7 | 4.3 |
| 55-60 | 324 | 421 | 116 | 39 | 2009 | 2.6 | 0.1 | 3.1 | 2.3 | 6646 | 48 | 2.4 | 3.3 | 4.2 |
| 60-65 | 291 | 425 | 107 | 35 | 1634 | 2.5 | 0.1 | 2.6 | 2.5 | 5941 | 45 | 2.0 | 3.0 | 4.2 |
| 65-70 | 296 | 471 | 92 | 32 | 1484 | 2.2 | 0.2 | 1.9 | 2.0 | 3897 | 35 | 1.6 | 2.4 | 3.3 |
| 70-75 | 178 | 308 | 78 | 25 | 1333 | 2.1 | 0.2 | 2.1 | 1.9 | 3954 | 36 | 1.4 | 2.0 | 3.3 |
| 75-80 | 360 | 603 | 133 | 45 | 1989 | 2.9 | 0.2 | 2.3 | 2.7 | 4702 | 43 | 1.9 | 2.9 | 4.1 |
| 80-85 | 198 | 354 | 90 | 22 | 1511 | 1.9 | 0.2 | 2.1 | 2.8 | 4507 | 39 | 1.6 | 2.3 | 3.3 |
| 85-90 | 195 | 346 | 100 | 24 | 1400 | 2.0 | 0.2 | 1.5 | 2.1 | 3649 | 33 | 1.4 | 2.2 | 2.7 |
| 90-95 | 258 | 369 | 93 | 28 | 1519 | 1.8 | 0.2 | 1.8 | 2.0 | 3859 | 32 | 1.5 | 2.0 | 2.6 |
| 95-100 | 289 | 465 | 118 | 33 | 1905 | 2.0 | 0.2 | 2.0 | 2.5 | 4326 | 37 | 1.8 | 2.6 | 3.6 |
| 100-105 | 430 | 514 | 120 | 57 | 1963 | 2.4 | 0.1 | 2.4 | 2.7 | 5122 | 41 | 2.2 | 3.1 | 4.0 |
| 105-110 | 362 | 508 | 134 | 29 | 1763 | 2.4 | 0.1 | 3.0 | 2.3 | 4340 | 38 | 2.0 | 2.6 | 4.1 |
| 110-115 | 467 | 643 | 124 | 80 | 2208 | 2.0 | 0.1 | 2.0 | 3.4 | 4194 | 37 | 2.3 | 2.8 | 5.2 |
| 115-120 | 303 | 511 | 136 | 32 | 2147 | 2.7 | 0.1 | 2.8 | 2.6 | 4582 | 36 | 1.9 | 2.8 | 3.7 |
| 120-125 | 320 | 529 | 147 | 33 | 2163 | 2.5 | 0.1 | 2.4 | 2.7 | 4604 | 38 | 1.9 | 3.1 | 3.7 |
| 125-130 | 406 | 592 | 133 | 39 | 2180 | 2.4 | 0.1 | 2.4 | 3.0 | 4886 | 39 | 2.0 | 3.1 | 4.1 |
| 130-135 | 339 | 506 | 117 | 31 | 1785 | 2.2 | 0.1 | 1.8 | 2.3 | 4137 | 35 | 1.9 | 2.5 | 4.0 |

| Depth | As | Ba | Be | Co | Li | Mo | Sr | Ti | V |
|---|---|---|---|---|---|---|---|---|---|
| (cm) | | | | | (mg/kg) | | | | |
| 0-5 | 4.0 | 29 | .21 | 1.8 | 1.7 | 1.6 | 12.6 | 487 | 23.4 |
| 5-10 | 2.3 | 25 | .12 | .9 | .9 | .9 | 10.5 | 244 | 9.5 |
| 10-15 | 3.2 | 32 | .18 | 1.7 | 1.3 | 1.3 | 11.9 | 358 | 22.4 |
| 15-20 | 4.2 | 37 | .24 | 2.2 | 3.5 | 2.3 | 15.4 | 510 | 29.6 |
| 20-25 | 3.3 | 25 | .21 | 2.4 | 4.2 | 2.4 | 12.1 | 365 | 18.9 |
| 25-30 | 4.8 | 29 | .31 | 3.5 | 4.1 | 2.8 | 19.2 | 483 | 29.1 |
| 30-35 | 2.7 | 19 | .26 | 3.4 | 3.1 | 2.2 | 10.6 | 312 | 16.4 |
| 35-40 | 3.8 | 17 | .22 | 2.6 | 1.9 | 1.6 | 14.2 | 312 | 15.1 |
| 40-45 | 2.8 | 13 | .20 | 2.4 | 1.3 | 1.3 | 10.7 | 310 | 18.5 |
| 45-50 | 2.6 | 14 | .18 | 2.2 | 1.3 | 1.2 | 13.2 | 246 | 12.1 |
| 50-55 | 3.3 | 15 | .23 | 2.5 | 1.2 | 1.3 | 12.2 | 516 | 25.2 |
| 55-60 | 2.8 | 16 | .30 | 3.5 | 1.5 | 1.5 | 13.6 | 494 | 34.0 |
| 60-65 | 5.0 | 23 | .21 | 2.1 | 1.0 | 1.0 | 20.4 | 392 | 21.9 |
| 65-70 | 2.6 | 15 | .18 | 1.7 | 1.0 | .9 | 13.7 | 318 | 14.8 |
| 70-75 | 3.2 | 15 | .18 | 1.8 | 1.1 | .9 | 11.6 | 319 | 13.8 |
| 75-80 | 3.2 | 14 | .22 | 2.7 | .8 | 1.0 | 12.4 | 328 | 19.5 |
| 80-85 | 3.0 | 14 | .18 | 1.7 | 1.2 | .9 | 14.8 | 249 | 11.1 |
| 85-90 | 3.4 | 12 | .16 | 1.6 | .8 | .9 | 14.4 | 228 | 11.8 |
| 90-95 | 3.1 | 16 | .19 | 1.9 | 1.1 | 1.1 | 13.4 | 383 | 15.9 |
| 95-100 | 3.5 | 19 | .21 | 2.2 | 1.2 | 1.2 | 15.1 | 415 | 15.6 |
| 100-105 | 2.6 | 15 | .17 | 1.6 | 1.0 | .9 | 12.9 | 314 | 12.9 |
| 105-110 | 1.9 | 14 | .17 | 1.7 | .8 | .8 | 14.4 | 256 | 14.7 |
| 110-115 | 2.5 | 23 | .20 | 2.2 | 2.7 | 1.3 | 12.5 | 420 | 15.8 |
| 115-120 | 2.8 | 20 | .22 | 2.6 | 1.6 | 1.3 | 15.1 | 470 | 17.0 |
| 120-125 | 2.3 | 22 | .22 | 2.3 | 1.6 | 1.3 | 15.3 | 361 | 11.0 |
| 125-130 | 2.9 | 20 | .23 | 2.3 | 1.6 | 1.9 | 13.1 | 468 | 16.4 |
| 130-135 | 3.0 | 17 | .18 | 1.7 | 1.3 | 1.0 | 14.3 | 333 | 13.0 |

Appendix 5. (Continued). Site 6

| Depth | Ca | Mg | K | Na | Al | B | Cd | Cr | Cu | Fe | Mn | Ni | Pb | Zn |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (cm) | | | | | | | (mg/kg) | | | | | | | |
| 0-5 | 412 | 572 | 239 | 25 | 4515 | 3.6 | 0.2 | 3.5 | 2.9 | 6995 | 109 | 2.6 | 9.6 | 17.3 |
| 5-10 | 254 | 464 | 193 | 21 | 3956 | 3.5 | <.1 | 3.8 | 1.9 | 6367 | 76 | 2.2 | 4.5 | 12.6 |
| 10-15 | 271 | 449 | 176 | 20 | 3865 | 3.0 | <.1 | 3.8 | 1.9 | 6049 | 100 | 2.3 | 4.7 | 11.2 |
| 15-20 | 294 | 761 | 251 | 31 | 7348 | 4.6 | 0.2 | 4.9 | 3.0 | 9564 | 101 | 4.5 | 6.9 | 18.4 |
| 20-25 | 196 | 557 | 190 | 23 | 5243 | 3.2 | 0.1 | 4.4 | 2.3 | 6827 | 75 | 3.2 | 4.9 | 12.1 |
| 25-30 | 411 | 851 | 206 | 26 | 6060 | 3.1 | 0.2 | 3.2 | 3.6 | 7463 | 68 | 4.9 | 5.3 | 11.8 |
| 30-35 | 353 | 733 | 212 | 24 | 5977 | 3.5 | 0.2 | 3.3 | 3.3 | 7436 | 50 | 4.3 | 4.8 | 11.1 |
| 35-40 | 224 | 667 | 180 | 23 | 5054 | 2.8 | 0.1 | 3.5 | 3.0 | 6967 | 47 | 3.7 | 4.3 | 10.0 |
| 40-45 | 208 | 605 | 171 | 22 | 4188 | 2.8 | 0.1 | 2.9 | 2.7 | 5783 | 42 | 3.1 | 3.5 | 8.9 |
| 45-50 | 213 | 618 | 174 | 22 | 3793 | 3.1 | 0.1 | 3.4 | 2.9 | 6721 | 45 | 3.1 | 3.7 | 7.3 |
| 50-55 | 301 | 661 | 163 | 22 | 3585 | 3.1 | 0.1 | 4.3 | 3.0 | 6472 | 45 | 3.1 | 3.8 | 8.2 |
| 55-60 | 238 | 524 | 128 | 19 | 2670 | 2.4 | 0.1 | 3.0 | 2.5 | 4914 | 36 | 2.3 | 2.8 | 3.9 |
| 60-65 | 300 | 601 | 176 | 23 | 2865 | 2.7 | <.1 | 3.5 | 3.2 | 5941 | 45 | 2.8 | 4.3 | 6.6 |
| 65-70 | 223 | 531 | 176 | 21 | 2556 | 2.6 | <.1 | 2.9 | 3.1 | 4849 | 38 | 2.5 | 3.5 | 5.2 |
| 70-75 | 198 | 507 | 178 | 21 | 2508 | 2.5 | <.1 | 2.7 | 3.2 | 5280 | 40 | 2.3 | 3.6 | 4.8 |
| 75-80 | 176 | 501 | 173 | 22 | 2337 | 2.4 | <.1 | 2.0 | 3.2 | 4363 | 36 | 2.1 | 3.3 | 3.9 |
| 80-85 | 242 | 481 | 171 | 28 | 2103 | 2.4 | <.1 | 2.5 | 3.1 | 4675 | 43 | 2.1 | 3.3 | 4.8 |
| 85-90 | 206 | 400 | 161 | 24 | 1949 | 2.5 | <.1 | 1.8 | 2.4 | 3419 | 39 | 1.6 | 3.4 | 4.2 |
| 90-95 | 275 | 525 | 175 | 30 | 1886 | 3.2 | <.1 | 2.7 | 3.5 | 4307 | 49 | 1.9 | 3.5 | 4.1 |
| 95-100 | 248 | 462 | 191 | 33 | 1739 | 2.5 | 0.1 | 1.5 | 2.7 | 3432 | 38 | 1.6 | 3.2 | 3.6 |
| 100-105 | 276 | 400 | 156 | 27 | 1528 | 2.4 | 0.1 | 1.8 | 2.4 | 3337 | 35 | 1.3 | 2.8 | 3.2 |
| 105-110 | 199 | 415 | 156 | 23 | 1609 | 2.4 | 0.1 | 1.2 | 2.7 | 3394 | 37 | 1.4 | 2.7 | 3.4 |
| 110-115 | 208 | 385 | 137 | 22 | 1469 | 2.1 | 0.1 | 1.2 | 2.5 | 3064 | 33 | 1.3 | 2.5 | 3.0 |
| 115-120 | 217 | 452 | 144 | 34 | 1593 | 2.4 | 0.1 | 1.5 | 2.5 | 3407 | 37 | 1.6 | 3.2 | 3.7 |
| 120-125 | 268 | 465 | 186 | 33 | 1761 | 2.8 | <.1 | 1.9 | 2.8 | 3721 | 41 | 1.6 | 3.3 | 3.4 |

| Depth | As | Ba | Be | Co | Li | Mo | Sr | Ti | V |
|---|---|---|---|---|---|---|---|---|---|
| (cm) | | | | | (mg/kg) | | | | |
| 0-5 | 3.8 | 50 | .22 | 2.0 | 3.1 | 2.0 | 12.4 | 395 | 18.8 |
| 5-10 | 3.2 | 43 | .21 | 2.0 | 2.8 | 1.9 | 11.0 | 346 | 19.3 |
| 10-15 | 2.4 | 43 | .19 | 1.9 | 2.8 | 1.8 | 10.4 | 281 | 17.4 |
| 15-20 | 3.4 | 75 | .27 | 2.7 | 5.0 | 2.9 | 12.7 | 459 | 22.0 |
| 20-25 | 2.9 | 43 | .25 | 2.5 | 4.0 | 2.4 | 11.3 | 423 | 21.4 |
| 25-30 | 3.3 | 44 | .33 | 3.1 | 4.4 | 2.9 | 12.2 | 505 | 23.9 |
| 30-35 | 3.4 | 39 | .33 | 2.7 | 3.4 | 2.5 | 12.6 | 437 | 20.2 |
| 35-40 | 3.5 | 41 | .32 | 2.7 | 3.1 | 2.3 | 12.4 | 444 | 20.5 |
| 40-45 | 3.1 | 32 | .30 | 2.6 | 2.6 | 2.0 | 11.9 | 363 | 19.8 |
| 45-50 | 6.2 | 34 | .27 | 2.2 | 2.1 | 1.6 | 31.9 | 258 | 14.7 |
| 50-55 | 2.9 | 32 | .31 | 3.1 | 2.6 | 2.0 | 9.2 | 293 | 19.6 |
| 55-60 | 3.0 | 25 | .27 | 2.8 | 2.1 | 1.6 | 11.9 | 429 | 21.1 |
| 60-65 | 2.9 | 29 | .25 | 2.5 | 1.8 | 1.4 | 13.7 | 384 | 17.9 |
| 65-70 | 3.1 | 22 | .24 | 2.4 | 1.6 | 1.3 | 12.9 | 396 | 20.0 |
| 70-75 | 3.1 | 22 | .23 | 2.1 | 1.5 | 1.2 | 13.4 | 316 | 17.1 |
| 75-80 | 2.9 | 20 | .22 | 2.0 | 1.4 | 1.2 | 11.7 | 274 | 16.0 |
| 80-85 | 3.1 | 19 | .22 | 2.1 | 1.7 | 1.3 | 13.0 | 203 | 14.7 |
| 85-90 | 2.4 | 17 | .18 | 1.5 | 1.4 | 1.0 | 10.0 | 141 | 9.8 |
| 90-95 | 1.8 | 15 | .14 | 1.2 | .9 | .7 | 8.1 | 98 | 6.7 |
| 95-100 | 2.5 | 15 | .17 | 1.5 | 1.2 | .9 | 10.2 | 222 | 10.6 |
| 100-105 | 2.9 | 14 | .18 | 1.5 | 1.0 | .8 | 11.2 | 249 | 12.3 |
| 105-110 | 3.2 | 17 | .20 | 1.6 | 1.2 | 1.0 | 13.4 | 259 | 12.5 |
| 110-115 | 2.4 | 17 | .17 | 1.4 | 1.1 | .8 | 11.2 | 210 | 10.4 |
| 115-120 | 2.6 | 15 | .18 | 1.5 | 1.2 | .9 | 12.0 | 205 | 11.0 |
| 120-125 | 2.3 | 14 | .16 | 1.3 | 1.0 | .8 | 11.4 | 163 | 8.7 |

Appendix 5. (Continued). Site 7

| Depth | Ca | Mg | K | Na | Al | B | Cd | Cr | Cu | Fe | Mn | Ni | Pb | Zn |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (cm) | (mg/kg) | | | | | | | | | | | | | |
| 0-5 | 3524 | 3900 | 622 | 53 | 6031 | 6.1 | 0.7 | 8.6 | 7.7 | 5628 | 972 | 3.9 | 23.5 | 50.2 |
| 5-10 | 1084 | 6470 | 416 | 48 | 5468 | 4.3 | 0.2 | 6.5 | 3.5 | 5402 | 158 | 2.6 | 7.3 | 14.1 |
| 10-15 | 1066 | 1275 | 549 | 65 | 11999 | 5.9 | 0.3 | 9.4 | 4.0 | 11959 | 125 | 5.4 | 13.2 | 22.7 |
| 15-20 | 1178 | 1559 | 552 | 73 | 16024 | 6.3 | 0.4 | 9.7 | 5.0 | 12789 | 110 | 9.1 | 14.3 | 25.3 |
| 20-25 | 1275 | 1687 | 518 | 75 | 15354 | 6.2 | 0.2 | 8.7 | 5.6 | 11880 | 87 | 10.3 | 13.2 | 25.5 |
| 25-30 | 1223 | 1596 | 466 | 68 | 12619 | 5.5 | 0.2 | 7.7 | 5.9 | 9975 | 76 | 9.4 | 11.4 | 20.6 |
| 30-35 | 1161 | 1575 | 429 | 64 | 10694 | 5.6 | 0.3 | 9.8 | 5.8 | 8920 | 72 | 8.3 | 10.5 | 16.9 |
| 35-40 | 1297 | 1554 | 407 | 62 | 9159 | 4.8 | 0.3 | 7.5 | 6.0 | 8216 | 78 | 7.5 | 9.9 | 13.7 |
| 40-45 | 1127 | 1383 | 343 | 53 | 7025 | 5.3 | 0.3 | 8.2 | 5.3 | 6846 | 69 | 6.4 | 8.6 | 10.5 |
| 45-50 | 1361 | 1482 | 381 | 64 | 7059 | 6.0 | 0.3 | 8.6 | 5.6 | 7506 | 75 | 6.8 | 8.9 | 11.0 |
| 50-55 | 1280 | 1361 | 337 | 58 | 5869 | 4.6 | 0.3 | 7.5 | 5.0 | 7182 | 73 | 6.0 | 8.5 | 9.4 |
| 55-60 | 1238 | 1300 | 284 | 54 | 5438 | 4.5 | 0.3 | 6.7 | 5.1 | 7077 | 74 | 5.7 | 7.9 | 8.6 |
| 60-65 | 1226 | 1389 | 310 | 51 | 5173 | 4.1 | 0.4 | 5.5 | 5.3 | 7418 | 71 | 5.7 | 8.1 | 8.8 |
| 65-70 | 1478 | 1526 | 358 | 65 | 6067 | 4.4 | 0.3 | 6.4 | 6.5 | 8304 | 84 | 6.2 | 8.7 | 9.8 |
| 70-75 | 1475 | 1713 | 396 | 67 | 5990 | 5.3 | 0.1 | 6.6 | 6.8 | 8416 | 85 | 6.6 | 9.2 | 10.7 |
| 75-80 | 1586 | 1655 | 360 | 69 | 5802 | 5.0 | 0.2 | 5.9 | 7.4 | 8429 | 87 | 6.6 | 7.7 | 10.4 |
| 80-85 | 1401 | 1649 | 353 | 70 | 5471 | 8.2 | 0.2 | 7.0 | 7.9 | 7683 | 86 | 6.9 | 7.4 | 10.2 |
| 85-90 | 1466 | 1634 | 353 | 75 | 5310 | 5.4 | 0.3 | 6.4 | 8.3 | 7963 | 93 | 7.1 | 7.4 | 10.2 |
| 90-95 | 1370 | 1577 | 346 | 71 | 5106 | 5.0 | 0.2 | 5.6 | 7.9 | 7503 | 87 | 6.8 | 6.9 | 10.6 |
| 95-100 | 1416 | 1774 | 362 | 64 | 5757 | 5.0 | 0.3 | 6.1 | 9.4 | 8984 | 74 | 7.8 | 7.8 | 10.7 |
| 100-105 | 1473 | 1881 | 371 | 71 | 5962 | 5.5 | 0.4 | 6.2 | 10.3 | 9321 | 77 | 8.3 | 9.2 | 11.6 |
| 105-110 | 1245 | 1466 | 317 | 62 | 4727 | 4.7 | 0.2 | 3.9 | 9.2 | 7025 | 65 | 6.8 | 6.3 | 8.4 |
| 110-115 | 1386 | 1703 | 344 | 63 | 5163 | 5.1 | 0.2 | 5.2 | 9.3 | 8144 | 75 | 7.4 | 7.7 | 10.9 |
| 115-120 | 1319 | 1636 | 332 | 65 | 5079 | 4.4 | 0.1 | 4.6 | 8.8 | 7504 | 76 | 7.2 | 7.0 | 10.1 |
| 120-125 | 1210 | 1353 | 291 | 61 | 4115 | 5.1 | <.1 | 5.0 | 7.4 | 6189 | 66 | 5.8 | 5.9 | 8.9 |
| 125-130 | 1432 | 1593 | 336 | 68 | 4961 | 4.6 | 0.1 | 5.4 | 9.7 | 7503 | 81 | 7.3 | 7.1 | 9.4 |
| 130-135 | 1396 | 1412 | 318 | 65 | 4354 | 4.5 | 0.2 | 5.2 | 7.5 | 7456 | 76 | 6.2 | 6.4 | 8.8 |
| 135-140 | 1636 | 1681 | 368 | 76 | 5573 | 4.8 | 0.1 | 5.2 | 9.5 | 8093 | 92 | 7.9 | 7.3 | 10.1 |
| 140-145 | 1718 | 1597 | 358 | 72 | 5103 | 4.7 | <.1 | 6.1 | 9.0 | 8312 | 90 | 7.5 | 7.3 | 10.2 |
| 145-150 | 1809 | 1682 | 381 | 80 | 5522 | 5.0 | 0.1 | 7.1 | 9.6 | 9269 | 102 | 7.7 | 8.0 | 10.6 |

| Depth | As | Ba | Be | Co | Li | Mo | Sr | Ti | V |
|---|---|---|---|---|---|---|---|---|---|
| (cm) | (mg/kg) | | | | | | | | |
| 0-5 | 3.0 | 259 | .21 | 2.3 | 2.2 | 2.4 | 25.8 | 670 | 18.7 |
| 5-10 | 2.5 | 140 | .21 | 1.8 | 2.8 | 2.4 | 16.7 | 801 | 20.8 |
| 10-15 | 4.3 | 95 | .55 | 5.4 | 10.9 | 5.9 | 16.7 | 1146 | 37.2 |
| 15-20 | | | | | | | | | |
| 20-25 | 4.7 | 82 | .55 | 5.2 | 8.8 | 5.3 | 16.0 | 1115 | 34.7 |
| 25-30 | 3.3 | 72 | .47 | 5.0 | 6.7 | 4.5 | 14.8 | 1074 | 32.8 |
| 30-35 | 3.4 | 68 | .46 | 5.0 | 5.8 | 4.1 | 16.3 | 1192 | 34.0 |
| 35-40 | 3.0 | 58 | .41 | 4.8 | 5.0 | 3.5 | 14.8 | 1097 | 32.7 |
| 40-45 | 2.7 | 39 | .32 | 3.8 | 3.9 | 2.7 | 12.4 | 934 | 27.2 |
| 45-50 | 2.7 | 34 | .31 | 3.6 | 3.6 | 2.5 | 11.8 | 945 | 27.1 |
| 50-55 | 2.7 | 33 | .33 | 4.0 | 3.6 | 2.5 | 13.6 | 1190 | 33.6 |
| 55-60 | 3.7 | 34 | .37 | 4.3 | 3.9 | 2.7 | 14.8 | 1201 | 38.1 |
| 60-65 | 2.9 | 32 | .38 | 4.5 | 4.5 | 2.3 | 13.7 | 1154 | 37.6 |
| 65-70 | 2.6 | 35 | .33 | 4.7 | 3.9 | 2.5 | 14.1 | 1060 | 32.6 |
| 70-75 | 2.7 | 34 | .34 | 4.3 | 3.8 | 2.4 | 14.1 | 1105 | 35.2 |
| 75-80 | 3.2 | 30 | .36 | 4.9 | 4.0 | 2.6 | 15.2 | 1082 | 39.1 |
| 80-85 | 2.5 | 28 | .34 | 5.3 | 4.2 | 2.4 | 13.4 | 699 | 23.4 |
| 85-90 | 2.6 | 23 | .31 | 5.0 | 3.8 | 2.1 | 12.0 | 597 | 19.6 |
| 90-95 | 3.3 | 26 | .37 | 5.5 | 4.2 | 2.4 | 13.7 | 845 | 31.0 |
| 95-100 | 3.4 | 29 | .34 | 4.6 | 4.3 | 2.3 | 12.7 | 895 | 31.5 |
| 100-105 | 3.1 | 28 | .34 | 4.7 | 4.2 | 2.4 | 13.5 | 903 | 31.4 |
| 105-110 | 2.8 | 24 | .31 | 4.6 | 3.8 | 2.0 | 11.5 | 754 | 26.9 |
| 110-115 | 3.1 | 29 | .37 | 5.0 | 4.2 | 2.4 | 13.9 | 931 | 32.8 |
| 115-120 | | | | | | | | | |
| 120-125 | 2.1 | 26 | .30 | 4.4 | 3.6 | 1.9 | 12.4 | 679 | 20.5 |
| 125-130 | 2.4 | 25 | .31 | 5.0 | 3.9 | 2.0 | 12.9 | 681 | 23.1 |
| 130-135 | 2.5 | 25 | .30 | 4.2 | 3.4 | 2.0 | 12.5 | 826 | 28.0 |
| 135-140 | 2.9 | 32 | .36 | 5.0 | 4.2 | 2.4 | 15.1 | 989 | 32.3 |
| 140-145 | 3.1 | 29 | .35 | 4.9 | 4.2 | 2.3 | 14.8 | 1007 | 33.2 |
| 145-150 | 3.1 | 36 | .39 | 5.1 | 4.1 | 2.5 | 15.7 | 1137 | 36.4 |

Appendix 5. (Continued). Site 8

| Depth | Ca | Mg | K | Na | Al | B | Cd | Cr | Cu | Fe | Mn | Ni | Pb | Zn |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (cm) | (mg/kg) | | | | | | | | | | | | | |
| 0-5 | 460 | 405 | 234 | 29 | 3210 | 4.4 | 0.2 | 4.8 | 4.2 | 6239 | 315 | 1.9 | 8.0 | 12.9 |
| 5-10 | 393 | 456 | 243 | 27 | 3032 | 4.9 | <.1 | 4.1 | 2.5 | 6883 | 86 | 1.8 | 5.0 | 7.7 |
| 10-15 | 649 | 832 | 250 | 27 | 4839 | 4.8 | 0.1 | 5.0 | 4.3 | 7804 | 95 | 3.2 | 5.9 | 7.9 |
| 15-20 | 602 | 842 | 216 | 23 | 4872 | 4.3 | 0.2 | 3.5 | 4.8 | 6251 | 96 | 3.6 | 4.8 | 6.7 |
| 20-25 | 503 | 783 | 202 | 25 | 4002 | 4.2 | 0.1 | 3.0 | 4.3 | 5308 | 75 | 3.5 | 4.0 | 6.4 |
| 25-30 | 508 | 755 | 182 | 22 | 3508 | 4.1 | 0.1 | 2.9 | 4.2 | 5019 | 67 | 3.5 | 3.6 | 5.8 |
| 30-35 | 618 | 864 | 214 | 28 | 3973 | 4.7 | 0.1 | 3.5 | 5.0 | 5674 | 78 | 4.2 | 4.0 | 7.1 |
| 35-40 | 476 | 934 | 176 | 20 | 3210 | 4.6 | 0.1 | 2.5 | 4.9 | 4510 | 57 | 3.3 | 3.7 | 5.5 |
| 40-45 | 470 | 812 | 171 | 21 | 2852 | 4.1 | 0.1 | 2.7 | 4.2 | 4018 | 48 | 3.2 | 2.8 | 4.7 |
| 45-50 | 529 | 809 | 189 | 23 | 2858 | 4.4 | 0.2 | 3.2 | 4.0 | 4863 | 53 | 3.1 | 3.8 | 5.2 |
| 50-55 | 482 | 755 | 183 | 20 | 2654 | 4.2 | 0.4 | 2.5 | 4.0 | 4328 | 50 | 2.8 | 3.5 | 5.0 |
| 55-60 | 436 | 700 | 177 | 18 | 2449 | 4.1 | 0.7 | 1.9 | 4.0 | 3792 | 48 | 2.6 | 3.3 | 4.8 |
| 60-65 | 515 | 807 | 190 | 22 | 2746 | 4.4 | 0.1 | 2.4 | 4.4 | 4561 | 53 | 3.1 | 3.6 | 5.0 |
| 65-70 | 611 | 813 | 188 | 24 | 2823 | 4.3 | 0.1 | 2.8 | 4.4 | 4500 | 61 | 3.0 | 3.7 | 4.9 |
| 70-75 | 582 | 848 | 188 | 23 | 2827 | 4.0 | 0.1 | 4.0 | 4.4 | 4459 | 69 | 3.0 | 3.5 | 5.1 |
| 75-80 | 576 | 800 | 195 | 27 | 2700 | 4.4 | 0.1 | 2.6 | 4.1 | 4316 | 53 | 2.9 | 3.8 | 5.3 |
| 80-85 | 629 | 901 | 217 | 24 | 2876 | 4.5 | 0.2 | 3.0 | 4.6 | 4939 | 60 | 3.3 | 4.0 | 5.1 |
| 85-90 | 586 | 887 | 208 | 26 | 2746 | 4.8 | 0.2 | 2.9 | 4.6 | 4253 | 57 | 3.1 | 3.9 | 5.6 |
| 90-95 | 637 | 870 | 198 | 27 | 2456 | 4.5 | 0.2 | 2.8 | 4.7 | 4458 | 58 | 3.0 | 4.1 | 5.4 |
| 95-100 | 687 | 854 | 188 | 28 | 2468 | 4.2 | 0.2 | 2.7 | 4.8 | 4663 | 59 | 3.0 | 4.3 | 5.3 |
| 100-105 | 632 | 699 | 165 | 23 | 2149 | 3.5 | 0.1 | 1.8 | 4.0 | 3693 | 52 | 2.6 | 3.6 | 4.7 |
| 105-110 | 758 | 882 | 194 | 37 | 2566 | 4.2 | 0.2 | 2.6 | 4.8 | 5273 | 66 | 3.3 | 5.2 | 5.9 |
| 110-115 | 800 | 996 | 212 | 37 | 2736 | 4.3 | 0.2 | 3.3 | 4.9 | 5129 | 69 | 3.3 | 5.2 | 5.8 |
| 115-120 | 808 | 818 | 206 | 60 | 2781 | 4.7 | 0.2 | 2.6 | 5.1 | 5681 | 66 | 3.5 | 4.9 | 5.6 |
| 120-125 | 728 | 936 | 221 | 36 | 3058 | 4.8 | 0.2 | 3.1 | 4.9 | 5195 | 66 | 3.6 | 5.3 | 5.6 |
| 125-130 | 726 | 907 | 194 | 35 | 2773 | 4.5 | <.1 | 2.5 | 4.9 | 4505 | 59 | 3.3 | 4.6 | 5.5 |
| 130-135 | 705 | 853 | 195 | 34 | 2706 | 4.4 | <.1 | 2.8 | 4.9 | 5129 | 61 | 3.3 | 4.8 | 5.6 |
| 135-140 | 684 | 801 | 196 | 33 | 2638 | 4.3 | 0.1 | 3.2 | 5.0 | 5753 | 63 | 3.3 | 4.9 | 5.6 |
| 140-145 | 669 | 846 | 202 | 32 | 2667 | 4.1 | 0.1 | 2.3 | 5.0 | 4930 | 60 | 3.3 | 4.9 | 5.2 |

| Depth | As | Ba | Be | Co | Li | Mo | Sr | Ti | V |
|---|---|---|---|---|---|---|---|---|---|
| (cm) | (mg/kg) | | | | | | | | |
| 0-5 | 3.9 | 44 | .18 | 1.7 | 1.2 | 1.6 | 10.0 | 667 | 19.0 |
| 5-10 | 2.6 | 50 | .18 | 1.6 | 1.3 | 1.4 | 9.8 | 570 | 16.9 |
| 10-15 | 2.6 | 24 | .23 | 2.8 | 2.7 | 2.2 | 8.1 | 640 | 23.2 |
| 15-20 | 3.2 | 25 | .31 | 4.4 | 3.4 | 2.8 | 10.0 | 848 | 30.2 |
| 20-25 | 2.3 | 17 | .24 | 3.3 | 2.6 | 1.8 | 7.9 | 506 | 17.6 |
| 25-30 | 2.1 | 19 | .25 | 3.4 | 2.7 | 1.8 | 8.3 | 462 | 14.2 |
| 30-35 | 2.3 | 19 | .27 | 3.8 | 3.0 | 2.7 | 8.2 | 603 | 21.0 |
| 35-40 | 2.0 | 19 | .25 | 3.1 | 2.7 | 1.7 | 7.2 | 451 | 16.6 |
| 40-45 | 2.2 | 21 | .26 | 3.0 | 2.5 | 1.7 | 8.9 | 471 | 20.9 |
| 45-50 | 2.2 | 18 | .24 | 2.6 | 2.4 | 1.5 | 8.0 | 285 | 9.3 |
| 50-55 | 1.6 | 18 | .23 | 2.6 | 2.0 | 1.4 | 7.5 | 434 | 16.9 |
| 55-60 | 3.4 | 20 | .27 | 3.0 | 2.2 | 1.6 | 9.0 | 657 | 23.7 |
| 60-65 | 1.8 | 19 | .23 | 2.6 | 1.9 | 1.3 | 7.3 | 536 | 17.8 |
| 65-70 | 1.6 | 18 | .23 | 2.5 | 2.1 | 1.3 | 7.0 | 439 | 13.9 |
| 70-75 | 2.0 | 19 | .25 | 2.6 | 1.9 | 1.4 | 7.2 | 471 | 12.2 |
| 75-80 | 2.2 | 25 | .24 | 2.3 | 1.8 | 1.2 | 7.3 | 432 | 12.5 |
| 80-85 | 1.6 | 20 | .24 | 2.8 | 1.9 | 1.3 | 7.8 | 352 | 8.2 |
| 85-90 | 1.7 | 19 | .21 | 2.2 | 1.9 | 1.1 | 7.1 | 236 | 6.9 |
| 90-95 | 1.7 | 18 | .23 | 2.4 | 1.6 | 1.1 | 7.6 | 362 | 10.3 |
| 95-100 | 2.3 | 19 | .26 | 2.7 | 1.8 | 1.3 | 8.8 | 664 | 23.5 |
| 100-105 | 2.6 | 22 | .30 | 3.4 | 2.0 | 1.6 | 9.7 | 835 | 30.4 |
| 105-110 | 2.0 | 31 | .24 | 2.4 | 1.8 | 1.2 | 9.3 | 518 | 18.0 |
| 110-115 | 2.2 | 21 | .25 | 2.7 | 1.7 | 1.2 | 8.9 | 595 | 18.0 |
| 115-120 | 2.4 | 26 | .29 | 3.1 | 1.8 | 1.3 | 9.5 | 772 | 26.9 |
| 120-125 | 1.2 | 19 | .26 | 2.9 | 1.8 | 1.3 | 9.2 | 492 | 16.2 |
| 125-130 | 1.3 | 21 | .27 | 3.2 | 1.8 | 1.3 | 9.8 | 440 | 16.8 |
| 130-135 | 1.5 | 23 | .25 | 2.7 | 1.6 | 1.2 | 9.4 | 546 | 15.7 |
| 135-140 | 2.5 | 22 | .31 | 3.4 | 1.8 | 1.5 | 9.3 | 873 | 32.8 |
| 140-145 | 2.2 | 19 | .26 | 2.7 | 1.7 | 1.3 | 8.0 | 654 | 22.5 |

Appendix 5. (Continued). Site 9

| Depth | Ca | Mg | K | Na | Al | B | Cd | Cr | Cu | Fe | Mn | Ni | Pb | Zn |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (cm) | | | | | | | (mg/kg) | | | | | | | |
| 0-5 | 237 | 448 | 185 | 21 | 3334 | 3.4 | 0.3 | 2.9 | 3.6 | 4346 | 39 | 1.6 | 9.3 | 9.4 |
| 5-10 | 169 | 609 | 205 | 22 | 5770 | 3.6 | 0.1 | 3.4 | 2.4 | 5986 | 45 | 2.3 | 5.6 | 8.7 |
| 10-15 | 127 | 561 | 192 | 20 | 6104 | 3.5 | 0.2 | 3.7 | 2.6 | 5364 | 40 | 2.7 | 4.8 | 7.8 |
| 15-20 | 149 | 669 | 205 | 20 | 6042 | 3.8 | 0.3 | 3.4 | 2.9 | 5249 | 40 | 3.3 | 5.0 | 7.8 |
| 20-25 | 122 | 648 | 172 | 15 | 4582 | 3.7 | 0.1 | 2.8 | 2.4 | 4605 | 37 | 3.0 | 4.2 | 6.0 |
| 25-30 | 132 | 658 | 178 | 15 | 3789 | 4.2 | <.1 | 2.7 | 2.3 | 4182 | 39 | 2.7 | 4.1 | 5.2 |
| 30-35 | 141 | 668 | 184 | 16 | 2992 | 4.6 | <.1 | 2.5 | 2.2 | 3760 | 42 | 2.4 | 4.0 | 4.5 |
| 35-40 | 172 | 721 | 185 | 15 | 2879 | 4.3 | 0.1 | 2.8 | 2.2 | 4052 | 60 | 2.5 | 3.9 | 5.6 |
| 40-45 | 302 | 710 | 179 | 17 | 2786 | 3.8 | <.1 | 2.7 | 2.7 | 4637 | 60 | 2.3 | 4.0 | 5.0 |
| 45-50 | 500 | 914 | 232 | 25 | 3193 | 4.5 | 0.1 | 5.2 | 3.1 | 7053 | 81 | 3.0 | 5.7 | 6.7 |
| 50-55 | 160 | 620 | 175 | 12 | 2257 | 3.8 | <.1 | 1.5 | 2.0 | 3585 | 45 | 1.6 | 3.1 | 4.4 |
| 55-60 | 180 | 684 | 241 | 13 | 2483 | 3.7 | <.1 | 1.9 | 2.2 | 3622 | 46 | 1.6 | 3.0 | 4.9 |
| 60-65 | 190 | 721 | 231 | 12 | 2483 | 3.9 | 0.2 | 2.1 | 2.0 | 3584 | 45 | 1.7 | 2.8 | 5.2 |
| 65-70 | 219 | 684 | 218 | 13 | 2388 | 3.6 | 0.1 | 2.1 | 2.0 | 3548 | 46 | 1.8 | 2.7 | 4.8 |
| 70-75 | 248 | 648 | 205 | 14 | 2294 | 3.3 | <.1 | 2.2 | 2.0 | 3511 | 47 | 1.9 | 2.7 | 4.3 |
| 75-80 | 192 | 640 | 222 | 12 | 2394 | 3.8 | <.1 | 1.7 | 2.1 | 2971 | 38 | 1.6 | 2.6 | 5.3 |
| 80-85 | 160 | 602 | 208 | 12 | 2434 | 3.1 | <.1 | 1.9 | 1.6 | 3410 | 35 | 1.5 | 2.7 | 4.3 |
| 85-90 | 166 | 613 | 197 | 12 | 2459 | 3.0 | <.1 | 1.9 | 1.7 | 3254 | 34 | 1.6 | 2.7 | 4.4 |
| 90-95 | 122 | 545 | 176 | 9 | 2093 | 2.7 | <.1 | 1.4 | 1.4 | 2658 | 29 | 1.3 | 1.9 | 3.8 |
| 95-100 | 184 | 621 | 188 | 10 | 1998 | 2.1 | <.1 | 1.5 | 1.6 | 2845 | 30 | 1.4 | 2.6 | 3.5 |
| 100-105 | 244 | 680 | 230 | 15 | 2434 | 3.1 | 0.2 | 2.3 | 2.1 | 4092 | 44 | 1.9 | 3.5 | 5.0 |
| 105-110 | 244 | 669 | 224 | 15 | 2290 | 3.1 | 0.2 | 2.4 | 2.1 | 3694 | 42 | 1.8 | 3.2 | 4.4 |
| 110-115 | 245 | 658 | 218 | 16 | 2147 | 3.1 | 0.2 | 2.6 | 2.0 | 3296 | 40 | 1.7 | 3.0 | 3.9 |
| 115-120 | 243 | 667 | 228 | 14 | 2376 | 3.6 | 0.1 | 2.5 | 2.1 | 3846 | 44 | 1.7 | 3.4 | 4.4 |
| 120-125 | 176 | 567 | 196 | 13 | 2255 | 2.6 | 0.3 | 2.2 | 1.6 | 3925 | 39 | 1.5 | 3.0 | 4.2 |
| 125-130 | 147 | 558 | 196 | 12 | 2250 | 2.2 | 0.2 | 2.8 | 1.5 | 3584 | 34 | 1.4 | 2.8 | 3.9 |
| 130-135 | 191 | 581 | 213 | 13 | 2263 | 2.9 | <.1 | 2.2 | 1.9 | 4267 | 40 | 1.5 | 3.1 | 4.5 |
| 135-140 | 138 | 505 | 176 | 9 | 1884 | 2.1 | 0.1 | 1.5 | 1.3 | 2612 | 24 | 1.2 | 2.2 | 3.6 |
| 140-145 | 135 | 525 | 155 | 11 | 1872 | 2.7 | <.1 | 1.8 | 1.6 | 2759 | 26 | 1.3 | 2.0 | 4.7 |
| 145-150 | 234 | 576 | 193 | 15 | 2037 | 2.6 | <.1 | 4.1 | 2.2 | 3972 | 41 | 1.7 | 2.9 | 5.3 |

| Depth | As | Ba | Be | Co | Li | Mo | Sr | Ti | V |
|---|---|---|---|---|---|---|---|---|---|
| (cm) | | | | | (mg/kg) | | | | |
| 0-5 | 2.6 | 35 | .16 | 1.1 | 1.8 | 1.4 | 4.7 | 453 | 11.8 |
| 5-10 | 2.1 | 27 | .24 | 2.2 | 4.9 | 2.2 | 5.9 | 787 | 18.0 |
| 10-15 | 2.7 | 29 | .31 | 3.0 | 5.3 | 2.9 | 7.4 | 1107 | 26.2 |
| 15-20 | 1.4 | 27 | .28 | 3.0 | 5.0 | 2.6 | 5.8 | 437 | 10.3 |
| 20-25 | 1.7 | 24 | .26 | 2.6 | 4.1 | 2.1 | 5.1 | 595 | 12.8 |
| 25-30 | 1.2 | 19 | .23 | 2.3 | 3.1 | 1.6 | 4.9 | 329 | 6.1 |
| 30-35 | 2.3 | 17 | .27 | 2.5 | 2.9 | 1.6 | 5.0 | 749 | 19.2 |
| 35-40 | 2.3 | 17 | .30 | 2.7 | 2.7 | 1.6 | 4.8 | 927 | 25.2 |
| 40-45 | 1.7 | 17 | .26 | 2.5 | 2.5 | 1.3 | 4.8 | 719 | 17.3 |
| 45-50 | 1.4 | 18 | .26 | 2.5 | 2.6 | 1.3 | 4.9 | 567 | 15.6 |
| 50-55 | 1.4 | 15 | .20 | 1.4 | 2.2 | .9 | 3.8 | 360 | 8.8 |
| 55-60 | 1.2 | 17 | .24 | 1.8 | 2.4 | 1.1 | 4.0 | 539 | 12.7 |
| 60-65 | 1.2 | 16 | .24 | 2.2 | 2.5 | 1.2 | 4.9 | 409 | 10.9 |
| 65-70 | 1.7 | 24 | .28 | 3.6 | 2.5 | 1.6 | 8.1 | 449 | 15.9 |
| 70-75 | 1.8 | 13 | .23 | 1.8 | 2.3 | 1.1 | 3.6 | 626 | 15.9 |
| 75-80 | 1.6 | 14 | .21 | 1.6 | 2.5 | 1.1 | 4.1 | 473 | 11.0 |
| 80-85 | 1.5 | 15 | .22 | 1.8 | 2.4 | 1.1 | 4.4 | 502 | 10.0 |
| 85-90 | 1.2 | 15 | .20 | 1.5 | 2.3 | .9 | 3.5 | 301 | 5.4 |
| 90-95 | 1.8 | 25 | .34 | 2.8 | 4.0 | 1.7 | 7.7 | 447 | 9.4 |
| 95-100 | 1.2 | 21 | .25 | 2.2 | 2.6 | 1.2 | 6.1 | 362 | 11.1 |
| 100-105 | 1.3 | 17 | .24 | 2.1 | 2.5 | 1.1 | 4.9 | 463 | 10.7 |
| 105-110 | 1.3 | 14 | .21 | 1.7 | 2.2 | .9 | 3.8 | 517 | 12.3 |
| 110-115 | 1.9 | 14 | .20 | 1.4 | 2.1 | .9 | 3.9 | 397 | 11.1 |
| 115-120 | 1.7 | 15 | .22 | 1.7 | 2.3 | 1.0 | 4.0 | 538 | 12.3 |
| 120-125 | 1.4 | 14 | .23 | 1.7 | 2.2 | 1.0 | 4.0 | 592 | 14.0 |
| 125-130 | 1.4 | 15 | .21 | 1.5 | 2.1 | 1.0 | 4.6 | 451 | 10.9 |
| 130-135 | 1.2 | 14 | .20 | 1.6 | 2.1 | .9 | 3.4 | 405 | 9.6 |
| 135-140 | 1.2 | 13 | .20 | 1.6 | 2.0 | .9 | 4.6 | 393 | 7.9 |
| 140-145 | 1.2 | 12 | .18 | 1.3 | 1.8 | .8 | 4.4 | 238 | 5.6 |
| 145-150 | 1.2 | 11 | .16 | 1.2 | 2.0 | .7 | 3.4 | 243 | 7.2 |

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